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QUARTERLY REPORT #5

FIELD DATA

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UTAH STATE UNIVERSITY
Soils Laboratory
Logan, Utah
SOIL ANALYSIS REPORT

COLLECTED BY Dr. A. Southard DATE _____ LOCATION Oil Shale Ua and Ub

Soil	Laboratory Number	Collector's Number	Depth in Inches (cm)	Horizon	Particle Size Distribution (in m.m.) (percent) Very Coarse Sand 2-1	Coarse Sand 1-0.5	Medium Sand 0.5-0.25	Fine Sand 0.25-0.10	Very Fine Sand 0.10-0.05	Silt (Hydrometer)	Clay (Hydrometer)	% Sand	% > 2 m.m.	Textural Class	
As	9	#67	0-5		10	9	12	19	9	27	14	59	39	SL	
	10		5-12		13	8	8	20	15	28	15	57	60	SL	
	11		12-25		14	9	7	16	12	34	14	52	67	SL	
	12		25-35		18	12	8	20	11	22	13	65	63	SL	
A	13	#68	0-8		7	4	4	15	18	38	14	48	28	L	
	14		8-20		10	6	4	13	12	40	20	40	55	L	
	15		20-33		22	11	5	8	7	35	17	48	44	L	
	16		33-50		17	10	6	13	10	36	17	47	77	L	

Soil	Laboratory Number	pH Saturated Paste	pH 1:5	Organic Matter: Organic Matter %	Organic Carbon %	Nitrogen %	C/N	Total Soluble Salts %	Electrical Conductivity EC x 10^3 Millimhos per cm @25°C	$CaCO_3$ equivalent per cent	Gypsum me./100g Soil	Gypsum %	Moisture Tensions 1/3 Atmos. %	15 Atmos. %	Liquid Limit %
As	9	8.0			1.4				.5	7.0			17.7	8.1	27
	10	8.2			1.5				.6	8.6			21.2	9.9	37
	11	8.7			1.2				1.0	10.7			23.9	9.4	35
	12	8.9			.6				1.8	7.9			18.2	6.7	30
A	13	8.1			1.5				.5	2.9			17.3	7.8	24
	14	8.1			1.4				.5	8.4			23.0	11.7	33
	15	8.6			1.0				.8	9.8			26.0	9.9	31
	16	8.7			.9				1.2	5.3			25.4	11.8	32

Soil	Laboratory Number	Cation Exchange Capacity	Extractable Cations NH_4OAc me/100g: Ca	Mg	Na	K	Available P ppm	Saturation Extract Soluble milliequivalents per liter: Na	K	CO_3	HCO_3	Cl	SO_4	Per Cent Moisture at Saturation	Plastic Index %
As	9			.4	.4	.3	6.9							38	NP
	10			1.0	1.3	.1	1.6							52	NP
	11			1.6	7.2	.1	1.1							51	NP
	12			1.6	8.4	.1	.8							40	NP
A	13			1.0	.5	.3	7.5							32	NP
	14			1.1	1.1	.2	2.1							47	3
	15			.6	4.6	.1	1.1							44	3
	16			.6	10.4	.2	2.8							48	4

UTAH STATE UNIVERSITY

Soils Laboratory

Logan, Utah

SOIL ANALYSIS REPORT

COLLECTED BY Dr. A. Southard DATE _____ LOCATION Oil Shale Ua and Ub

Soil	Laboratory Number	Collector's Number	Depth in ~~inches~~ Cm	Horizon	Particle Size Distribution (in mm.) (percent) Very Coarse Sand 2-1	Coarse Sand 1-0.5	Medium Sand 0.5-0.25	Fine Sand 0.25-0.10	Very Fine Sand 0.10-0.05	% Silt (Hydrometer)	% Clay (Hydrometer)	% Sand (Hydrometer)	% > 2 mm.	Textural Class
W	17	#75	0-10		7	1	1	1	2	62	23	15	0	SiL
	18		10-20		<1	1	1	5	9	60	17	23	0	SiL
	19		20-30		1	1	<1	1	2	59	38	3	0	SiCL
	20		30-65		<1	<1	<1	1	2	64	34	2	0	SiCL
	21		65-90		<1	<1	1	40	31	17	8	75	0	SL
	22		90-130		<1	<1	<1	29	37	23	8	69	0	SL
	23		130-195		1	1	<1	2	4	68	17	15	0	SiL

Soil	Laboratory Number	pH Saturated Paste	pH 1:5	Organic Matter: Organic Matter %	Organic Carbon %	Nitrogen %	C/N	Total Soluble Salts %	Electrical Conductivity EC x 10^3 Millimhos per cm @ 25°C	$CaCO_3$ equivalent per cent	Gypsum me./100g Soil	Gypsum %	Moisture Tensions: 1/3 Atmos. %	15 Atmos. %	Liquid Limit %
W	17	8.2			5.1				1.4	11.3			34.3	14.7	47
	18	8.2			1.1				1.5	11.0			22.2	8.4	26
	19	8.0			1.2				14.0	12.0			32.0	15.4	39
	20	8.1			1.0				24.0	11.4			30.9	12.6	33
	21	8.2			.3				16.0	6.0			7.7	3.8	*
	22	8.3			.5				16.0	7.1			9.8	4.1	*
	23	8.1			.8				28.0	12.3			31.0	9.3	31

*Too Sandy

Soil	Laboratory Number	Cation Exchange Capacity	Extractable Cations (NH_4OAc me/100g): Ca	Mg	Na	K	Available P ppm	Saturation Extract Soluble (milliequivalents per liter): Na	K	CO_3	HCO_3	Cl	SO_4	Per Cent Moisture at Saturation	Plastic Index %
W	17			5.5	1.3	2.7	27							67	8
	18			4.0	1.6	1.7	2.1							47	2
	19			8.9	7.8	1.5	2.0							65	16
	20			11.5	13.3	.7	2.0							60	12
	21			4.5	4.6	.2	1.2							33	*
	22			5.8	5.7	.1	.7							34	*
	23			10.0	13.3	.3	.7							51	6

*Too Sandy

UTAH STATE UNIVERSITY
Soils Laboratory
Logan, Utah
SOIL ANALYSIS REPORT

COLLECTED BY Dr. A. Southard DATE _____ LOCATION Oil Shale Ua and Ub

Soil	Laboratory Number	Collector's Number	Depth in ~~inches~~ cm	Horizon	Particle Size Distribution (in mm.) (percent) Very Coarse Sand 2-1	Coarse Sand 1-0.5	Medium Sand 0.5-0.25	Fine Sand 0.25-0.10	Very Fine Sand 0.10-0.05	% Silt – Hydrometer –	% Clay – Hydrometer –	% Sand – Hydrometer –	% > 2 mm.	Textural Class
E	24	#76	0-10		2	2	3	15	32	31	8	61	2	SL
	25		10-23		1	1	2	9	23	41	16	43	1	L
	26		23-47		1	1	1	6	24	45	23	32	0	L
	27		47-75		3	3	6	20	17	33	19	48	3	L
	28		75-120		4	6	8	22	14	29	14	57	14	SL
	29		120-150		8	8	9	22	13	25	14	61	26	SL

Soil	pH Saturated Paste	pH 1:5	Organic Matter: Organic Matter %	Organic Matter: Organic Carbon %	Organic Matter: Nitrogen %	Organic Matter: C/N	Total Soluble Salts %	Electrical Conductivity EC x 10^3 Millimhos per cm @ 25°C	$CaCO_3$ equivalent per cent	Gypsum me./100g soil	Gypsum %	Moisture Tensions: 1/3 Atmos. %	Moisture Tensions: 15 Atmos. %	Liquid Limit %
E 24	8.2			.6				.5	5.2			11.8	5.0	20
25	8.2			.5				.7	12.5			17.3	7.1	22
26	8.4			.4				.7	18.7			23.0	9.4	27
27	8.6			.3				.9	11.9			21.6	8.6	23
28	8.1			.4				4.2	9.4			16.8	6.9	23
29	8.0			.4				18.0	7.8			16.1	6.4	22

Soil	Cation Exchange Capacity	Extractable Cations (NH4OAc me/100g): Ca	Mg	Na	K	Available P ppm	Saturation Extract Soluble (milliequivalents per liter): Na	K	CO_3	HCO_3	Cl	SO_4	Per Cent Moisture at Saturation	Plastic Index %
E 24			1.5	.3	.4	7.9							31	NP
25			2.6	.6	.2	1.3							33	NP
26			3.3	1.7	.2	.8							37	8
27			2.4	3.5	.2	.7							31	1
28			1.7	5.2	.1	1.0							34	NP
29			1.7	10.1	.2	1.4							30	NP

UTAH STATE UNIVERSITY

Soils Laboratory

Logan, Utah

SOIL ANALYSIS REPORT

COLLECTED BY Dr. A. Southard DATE _____ LOCATION Oil Shale Ua and Ub

Soil	Laboratory Number	Collector's Number	Depth in cm	Horizon	Particle Size Distribution (in mm.) (percent) Very Coarse Sand 2-1	Coarse Sand 1-0.5	Medium Sand 0.5-0.25	Fine Sand 0.25-0.10	Very Fine Sand 0.10-0.05	% Silt – Hydrometer –	% Clay – Hydrometer –	% Sand – Hydrometer –	% > 2 mm.	Textural Class
F	8	#39	0-4		2	11	30	29	8	9	8	83	4	LS
	9		4-17		6	13	30	25	6	11	11	78	7	SL
	10		17-35		11	19	27	21	5	8	10	82	25	LS
Ds	11	#40	0-6		7	9	15	27	12	22	12	66	18	SL
	12		6-31		11	10	13	23	12	24	9	67	21	SL
	13		31-137		12	12	14	23	11	21	9	70	23	SL

Soil	Laboratory Number	pH Saturated Paste	pH 1:5	Organic Matter: Organic Matter %	Organic Carbon %	Nitrogen %	C/N	Total Soluble Salts %	Electrical Conductivity EC x 10^3 Millimhos per cm @ 25°C	$CaCO_3$ equivalent per cent	Gypsum me./100g Soil	Gypsum %	Moisture Tensions 1/3 Atmos. %	Moisture Tensions 15 Atmos. %
F	8	8.1			.5				.6	3.0			8.1	4.6
	9	8.2			.5				.5	3.7			9.3	5.8
	10	8.5			.5				.3	6.8			10.4	6.3
Ds	11	8.0			.9				.9	13.4			13.9	6.0
	12	8.3			.5				.4	9.7			11.9	5.7
	13	8.2			.5				1.9	7.8			12.9	6.2

Soil	Laboratory Number	Cation Exchange Capacity	Extractable Cations ppm (NH_4OAc) Ca	Mg	Na	K	Available P ppm	Saturation Extract Soluble (milliequivalents per liter) Na	K	CO_3	HCO_3	Cl	SO_4	Per Cent Moisture at Saturation
F	8			1.0	.3	.4	16							29
	9			1.3	.5	.2	3.2							32
	10			1.0	.5	<.1	1.0							38
Ds	11			1.9	.4	1.1	24							34
	12			1.9	.4	.7	4.9							32
	13			2.3	2.8	.2	3.5							33

R. O. Lambson

UTAH STATE UNIVERSITY

Soils Laboratory

Logan, Utah

SOIL ANALYSIS REPORT

COLLECTED BY Dr. A. Southard DATE _____ LOCATION Oil Shale Ua and Ub

Soil	Laboratory Number	Collector's Number	Depth In cm	Horizon	Particle Size Distribution (in mm.) (percent) Very Coarse Sand 2-1	Coarse Sand 1-0.5	Medium Sand 0.5-0.25	Fine Sand 0.25-0.10	Very Fine Sand 0.10-0.05	% Silt – Hydrometer	% Clay	% Sand	% > 2 mm.	Textural Class
As	14	#42	0-6		9	16	15	19	8	23	10	67	29	SL
	15		6-13		10	15	14	20	9	28	10	62	27	SL
	16		13-41		15	10	8	17	9	36	10	54	31	SL
	17		41-60		14	9	5	13	14	40	13	47	28	L
Ds	18	#45	0-4		8	7	9	22	13	31	12	57	22	SL
	19		4-23		9	10	12	26	12	25	12	63	31	SL
	20		23-40		7	9	11	24	12	26	11	63	18	SL
	21		40-76		7	7	9	22	13	26	13	61	18	SL
	22		76-121		11	13	13	21	8	20	13	67	41	SL

Soil	Laboratory Number	pH Saturated Paste	pH 1:5	Organic Matter: Organic Matter %	Organic Carbon %	Nitrogen %	C/N	Total Soluble Salts %	Electrical Conductivity EC x 10^3 Millimhos per cm @ 25°C	$CaCO_3$ equivalent per cent	Gypsum: me./100g Soil	Gypsum %	Moisture Tensions: 1/3 Atmos. %	15 Atmos. %
As	14	8.1			1.5				.5	7.4			15.0	8.0
	15	8.1			2.4				.3	10.7			20.6	12.7
	16	8.5			1.2				.4	13.6			20.3	8.7
	17	8.6			.8				1.9	12.6			21.3	8.9
Ds	18	7.9			.8				.4	6.0			13.8	6.2
	19	8.2			1.0				.3	8.1			12.9	7.2
	20	8.3			.6				2.4	8.3			13.8	7.5
	21	8.2			.4				13.0	7.6			14.9	7.8
	22	8.3			.2				19.0	9.7			13.7	7.1

Soil	Laboratory Number	Extractable Cations ppm: Cation Exchange Capacity	Ca	Mg	Na	K	Available P ppm	Saturation Extract Soluble: Na	K	CO_3	HCO_3	Cl	SO_4	Per Cent Moisture at Saturation
			NH_4OAc					milliequivalents per liter						
As	14			.8	.3	.2	3.8							38
	15			1.0	.4	.1	2.2							58
	16			2.7	1.0	.1	.5							52
	17			5.2	6.4	.1	.3							51
Ds	18			.7	.3	.4	3.3							29
	19			1.2	.4	.2	1.0							41
	20			2.0	3.3	.1	.3							34
	21			2.4	9.7	.1	.3							35
	22			2.9	14.0	.1	1.5							33

R. C. Hawkins

UTAH STATE UNIVERSITY

Soils Laboratory

Logan, Utah

SOIL ANALYSIS REPORT

COLLECTED BY Dr. A. Southard DATE _____ LOCATION Oil Shale Ua and Ub

Soil	Laboratory Number	Collector's Number	Depth in ~~Inches~~ Cm	Horizon	Particle Size Distribution (in mm.) (percent): Very Coarse Sand 2-1	Coarse Sand 1-0.5	Medium Sand 0.5-0.25	Fine Sand 0.25-0.10	Very Fine Sand 0.10-0.05	% Silt – Hydrometer	% Clay – Hydrometer	% Sand – Hydrometer	% > 2 mm.	Textural Class
A	23	#46	0-6		18	9	4	8	11	40	13	47	23	L
	24		6-20		12	7	3	5	6	62	13	25	35	SiL
	25		20-45		12	7	3	5	6	59	14	27	34	SiL
N	26	#48	0-9		1	1	3	16	33	33	10	57	1	SL
	27		9-20		<1	1	2	12	26	34	27	39	1	L
	28		20-34		<1	1	2	8	15	35	38	27	0	CL
	29		34-55		<1	1	3	12	16	35	31	34	1	CL
	30		55-89		<1	1	2	7	21	40	30	30	0	CL
	31		89-158		1	2	2	8	17	46	26	28	2	L

Soil	Laboratory Number	pH: Saturated Paste	pH: 1:5	Organic Matter: Organic Matter %	Organic Matter: Organic Carbon %	Organic Matter: Nitrogen %	Organic Matter: C/N	Total Soluble Salts %	Electrical Conductivity EC x 10^3 Millimhos per cm @ 25°C	$CaCO_3$ equivalent per cent	Gypsum: me./100g soil	Gypsum: %	Moisture Tensions: 1/3 Atmos. %	Moisture Tensions: 15 Atmos. %
A	23	8.0			1.1				.5	8.3			20.1	7.3
	24	8.3			1.2				.4	23.4			28.9	9.6
	25	8.7			1.0				1.1	16.4			32.5	9.1
N	26	8.7			.3				.9	4.5			9.8	3.6
	27	8.9			.3				2.4	10.5			26.4	11.3
	28	8.5			.3				14.0	15.2			26.8	14.0
	29	8.2			.2				33.0	15.5			20.2	10.5
	30	8.1			.2				22.0	15.4			18.9	8.3
	31	8.3			.1				20.0	11.7			18.9	8.3

Soil	Laboratory Number	Cation Exchange Capacity	Extractable Cations ppm (NH_4OAc): Ca	Mg	Na	K	Available P ppm	Saturation Extract Soluble (milliequivalents per liter): Na	K	CO_3	HCO_3	Cl	SO_4	% Moist. at Sat.
A	23			2.2	.4	.3	7.3							39
	24			5.0	.9	.1	1.5							56
	25			8.6	3.0	.1	1.5							57
N	26			2.4	1.7	.9	6.4							28
	27			3.9	11.4	.3	3.4							48
	28			5.7	19.8	.2	1.8							62
	29			5.7	19.6	.2	1.0							48
	30			5.0	15.7	.1	1.0							48
	31			5.0	13.5	.2	.6							49

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UTAH STATE UNIVERSITY

Soils Laboratory

Logan, Utah

SOIL ANALYSIS REPORT

COLLECTED BY Dr. A. Southard DATE _____ LOCATION Oil Shale Ua and Ub

Soil	Laboratory Number	Collector's Number	Depth in Inches cm	Horizon	Particle Size Distribution (in mm.) (percent): Very Coarse Sand 2-1	Coarse Sand 1-0.5	Medium Sand 0.5-0.25	Fine Sand 0.25-0.10	Very Fine Sand 0.10-0.05	% Silt – Hydrometer	% Clay – Hydrometer	% Sand – Hydrometer	% > 2 mm.	Textural Class
A	32	#50	0-11		4	3	2	10	18	44	16	40	21	L
	33		11-30		12	6	3	10	13	44	15	41	41	L
	34		30-42		21	13	6	11	8	35	14	51	60	L
	35		42-49		23	14	6	16	7	27	17	56	57	SL

Soil	Laboratory Number	pH: Saturated Paste	pH: 1:5	Organic Matter: Organic Matter %	Organic Matter: Organic Carbon %	Organic Matter: Nitrogen %	Organic Matter: C/N	Total Soluble Salts %	Electrical Conductivity EC x 10^3 Millimhos per cm @ 25°C	$CaCO_3$ equivalent per cent	Gypsum: me./100g Soil	Gypsum: %	Moisture Tensions: 1/3 Atmos. %	Moisture Tensions: 15 Atmos. %
A	32	8.0			1.1				.8	3.9			19.4	9.4
	33	8.2			1.1				.4	15.9			20.7	9.8
	34	9.0			.8				1.1	10.9			26.1	11.2
	35	8.5			.7				5.4	8.5			24.2	11.4

Soil	Laboratory Number	Cation Exchange Capacity	Extractable Cations NH_4OAc: Ca	Mg	Na	K	Available P ppm	Saturation Extract Soluble (milliequivalents per liter): Na	K	CO_3	HCO_3	Cl	SO_4	Percent Moisture at Saturation
A	32			2.9	1.0	.8	7.4							36
	33			2.9	1.4	.1	1.1							56
	34			2.6	10.9	.8	1.0							46
	35			3.5	13.5	.2	3.5							46

R. E. Lamborn

UTAH STATE UNIVERSITY
Soils Laboratory
Logan, Utah
SOIL ANALYSIS REPORT

COLLECTED BY Dr. A. R. Southard DATE _____ LOCATION Oil Shale Ua and Ub

Soil	Laboratory Number	Collector's Number	Depth in cm	Horizon	Particle Size Distribution (in mm.) (percent): Very Coarse Sand 2-1	Coarse Sand 1-0.5	Medium Sand 0.5-0.25	Fine Sand 0.25-0.10	Very Fine Sand 0.10-0.05	% Silt – Hydrometer –	% Clay – Hydrometer –	% Sand – Hydrometer –	% > 2 mm.	Textural Class
As	52	53	0-8		14	8	6	14	14	31	13	56	32	SL
	53		8-23		10	7	4	11	11	46	10	44	26	L
	54		23-45		11	7	4	11	13	52	10	38	35	SiL
Ds	55	58	0-10		1	2	5	34	24	29	10	61	2	SL
	56		10-34		6	9	16	35	12	14	10	76	6	SL
	57		34-72		12	15	20	29	7	10	6	84	38	LS
	58		72-127		23	14	13	20	8	14	9	77	61	SL

Soil	Laboratory Number	pH: Saturated Paste	pH: 1:5	Organic Matter: Organic Matter %	Organic Matter: Organic Carbon %	Organic Matter: Nitrogen %	Organic Matter: C/N	Total Soluble Salts %	Electrical Conductivity EC x 10^3 Millimhos per cm @25°C	$CaCO_3$ equivalent per cent	Gypsum: me./100g soil	Gypsum: %	Moisture Tensions: 1/3 Atmos. %	Moisture Tensions: 15 Atmos. %
As	52	7.9			1.5				.5	4.9			17.4	9.7
	53	7.8			1.8				.5	13.4			24.8	12.4
	54	8.7			.7				2.5	12.4			27.6	13.3
Ds	55	9.9			.5				5.0	6.2			11.3	5.8
	56	10.4			.3				12.0	5.7			8.7	6.6
	57	8.0			.3				15.0	5.3			7.6	6.0
	58	8.0			.2				3.5	14.6			10.8	5.8

Soil	Laboratory Number	Cation Exchange Capacity	Extractable Cations (NH_4OAc me/100g): Ca	Mg	Na	K	Available P ppm	Saturation Extract Soluble (milliequivalents per liter): Na	K	CO_3	HCO_3	Cl	SO_4	Per Cent Moisture at Saturation
As	52			.6	.4	.4	11							41
	53			.7	.9	.1	1.4							58
	54			1.1	8.4	.1	.6							56
Ds	55			1.2	6.9	1.3	8.9							41
	56			.4	10.3	.3	10.9							30
	57			.9	3.1	.1	2.1							26
	58			1.5	1.4	.1	1.8							28

UTAH STATE UNIVERSITY

Soils Laboratory

Logan, Utah

SOIL ANALYSIS REPORT

COLLECTED BY Dr. A. R. Southard DATE _____ LOCATION Oil Shale Ua and Ub

Soil	Laboratory Number	Collector's Number	Depth in cm	Horizon	Particle Size Distribution (in mm.) (percent): Very Coarse Sand 2-1	Coarse Sand 1-0.5	Medium Sand 0.5-0.25	Fine Sand 0.25-0.10	Very Fine Sand 0.10-0.05	% Silt (Hydrometer)	% Clay (Hydrometer)	% Sand (Hydrometer)	% > 2 mm.	Textural Class
E	43	55	0-5		3	1	2	14	41	31	9	60	4	SL
	44		5-15		2	2	3	12	35	35	10	55	3	SL
	45		15-40		3	2	3	12	31	39	10	51	5	L
	46		40-120		3	4	4	14	25	38	10	52	6	SL
	47		120-160		3	4	6	16	21	34	12	54	9	SL
A	48	54	0-8		8	5	6	20	17	29	13	58	20	SL
	49		8-17		8	5	6	22	18	29	13	58	16	SL
	50		17-30		16	8	6	15	10	27	19	54	38	SL
	51		30-33		22	13	5	8	5	33	20	47	38	L

Soil	Laboratory Number	pH: Saturated Paste	pH: 1:5	Organic Matter: Organic Matter %	Organic Matter: Organic Carbon %	Organic Matter: Nitrogen %	Organic Matter: C/N	Total Soluble Salts %	Electrical Conductivity EC x 10^3 Millimhos per cm @ 25°C	$CaCO_3$ equivalent per cent	Gypsum: me./100g soil	Gypsum: %	Moisture Tensions: 1/3 Atmos. %	Moisture Tensions: 15 Atmos. %
E	43	7.7			.7				.8	2.9			10.0	4.8
	44	7.8			.4				.6	3.1			11.0	5.5
	45	7.8			.3				.4	4.9			12.4	5.9
	46	8.0			.4				.8	4.9			13.5	6.3
	47	7.7			.3				16.0	6.0			14.6	6.4
A	48	7.9			.8				.5	6.8			15.0	7.5
	49	7.9			.7				.3	9.3			17.2	9.2
	50	7.9			.8				.3	11.5			20.4	12.0
	51	8.0			.8				.4	7.3			21.0	11.1

Soil	Laboratory Number	Cation Exchange Capacity	Extractable Cations (NH_4OAc me/100g): Ca	Mg	Na	K	Available P ppm	Saturation Extract Soluble (milliequivalents per liter): Na	K	CO_3	HCO_3	Cl	SO_4	Per Cent Moisture at Saturation
E	43			2.7	.3	1.4	24							33
	44			2.5	.3	.5	2.6							28
	45			2.7	.4	.2	1.8							33
	46			3.4	1.1	.2	1.9							35
	47			4.4	6.7	.3	9.2							34
A	48			10.4	.3	.4	7.1							29
	49			1.5	.3	.1	.6							39
	50			1.9	.5	.1	.5							42
	51			1.9	.8	.1	.6							41

UTAH STATE UNIVERSITY
Soils Laboratory
Logan, Utah

SOIL ANALYSIS REPORT

COLLECTED BY Dr. A. Southard DATE _____ LOCATION Oil Shale Ua and Ub

Soil	Laboratory Number	Collector's Number	Depth in ~~inches~~ cms	Horizon	Particle Size Distribution (in mm.) (percent) Very Coarse Sand 2-1	Coarse Sand 1-0.5	Medium Sand 0.5-0.25	Fine Sand 0.25-0.10	Very Fine Sand 0.10-0.05	% Silt (Hydrometer)	% Clay (Hydrometer)	% Sand (Hydrometer)	% > 2 mm.	Textural Class
Ds	1	#64	0-10		9	9	11	21	11	27	11	62	13	SL
	2		10-40		14	14	14	23	9	19	11	70	24	SL
	3		40-65		12	14	13	20	9	23	12	65	20	SL
	4		65-113		11	16	15	21	9	21	11	68	15	SL
	5		113-150		12	12	13	22	11	23	10	67	21	SL
As	6	#66	0-5		8	10	15	27	9	24	11	65	20	SL
	7		5-15		7	10	14	28	10	21	10	69	40	SL
	8		15-30		13	11	12	30	9	19	13	68	52	SL

Soil	Laboratory Number	pH Saturated Paste	pH 1:5	Organic Matter %	Organic Carbon %	Nitrogen %	C/N	Total Soluble Salts %	Electrical Conductivity EC x 10^3 Millimhos per cm @ 25°C	$CaCO_3$ equivalent per cent	Gypsum me./100g Soil	Gypsum %	Moisture Tensions 1/3 Atmos. %	Moisture Tensions 15 Atmos. %	Liquid Limit %
Ds	1	8.1			1.1				.6	5.8			14.2	6.0	23
	2	8.1			.5				.4	5.9			11.8	5.6	21
	3	8.1			.4				.6	9.2			12.4	6.2	21
	4	8.1			.4				2.6	7.5			11.6	5.8	21
	5	8.1			.3				28.0	7.2			13.7	6.0	20
As	6	8.1			1.1				.5	12.6			14.1	6.7	24
	7	8.1			1.4				.4	9.8			15.2	7.5	28
	8	8.0			1.8				.4	17.8			20.3	11.4	36

Soil	Laboratory Number	Cation Exchange Capacity	Extractable Cations NH_4OAc me/100g Ca	Mg	Na	K	Available P ppm	Saturation Extract Soluble millequivalents per liter Na	K	CO_3	HCO_3	Cl	SO_4	Per Cent Moisture at Saturation	Plastic Index %
Ds	1		1.1	.3	.3	17								32	NP
	2		.9	.5	.1	3.6								30	NP
	3		.5	.8	.1	3.7								31	NP
	4		.9	3.8	.1	4.1								33	NP
	5		1.5	12.9	.2	2.4								29	NP
As	6		.5	.4	.2	2.6								38	NP
	7		.7	.4	.1	1.2								46	NP
	8		.8	.4	.1	1.5								50	NP

P&L

Results of the boron tests on soil samples from tract Ua and Ub.

Soil	Pedon #	Depth-cm (in)	Boron
Ds	#64	10-40 (3.9-15.7)	.3 ppm
	#63	113-150 (44.5-59)	.4
W	#75	30-65 (11.8-25.6)	.4
	#75	130-195 (51.2-76.8)	.2
E	#76	120-150 (47.2-59)	.5
Ds	#45	40-76 (15.7-29.9)	1.4
	#45	76-121 (29.9-47.6)	.9
N	#48	20-34 (7.9-13.4)	1.3
	#48	34-55 (13.4-21.7)	1.0

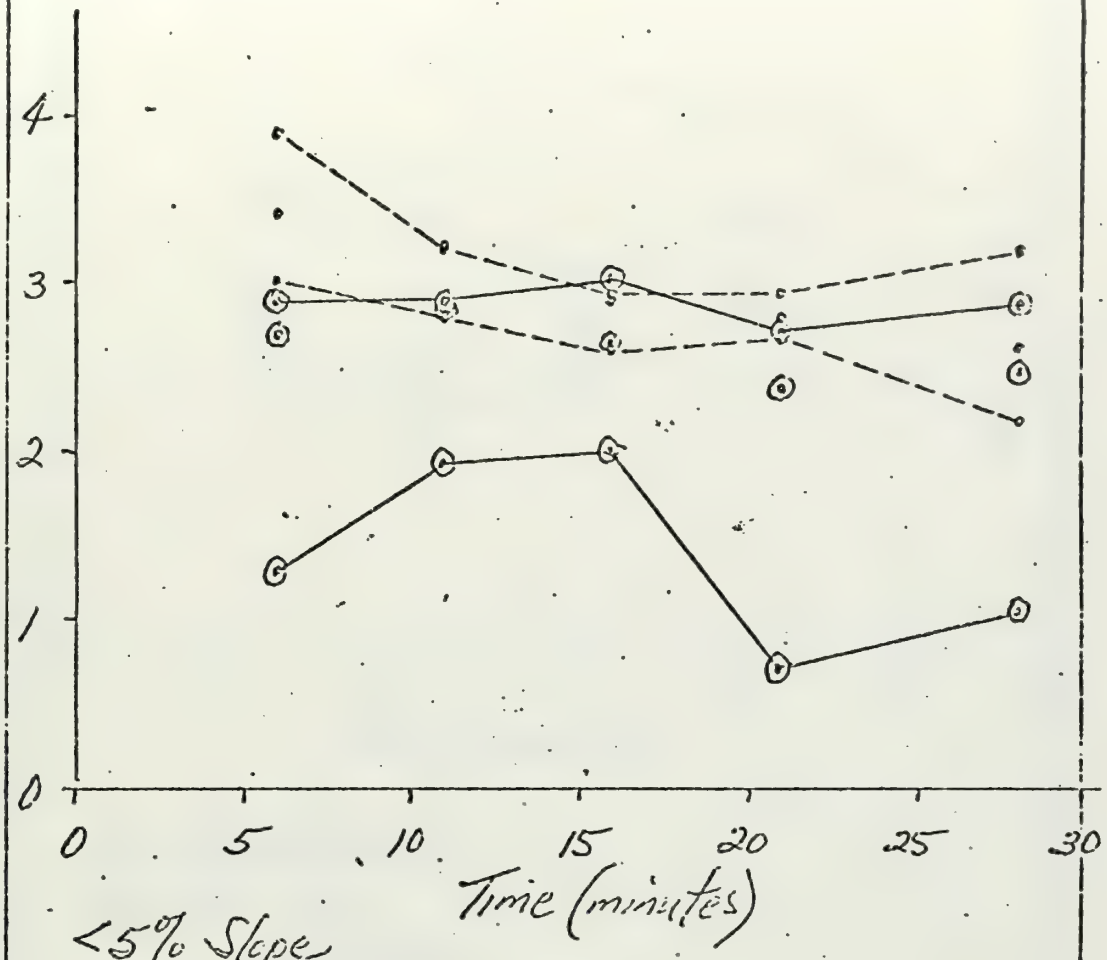
Results of X-ray Analysis of 15 soil samples from ~~oil shale~~ tracts Ua and Ub

Sample #	Depth (cm)	Quartz	Calcite	Dolomite	Feldspar	Illite	Kaolinite	Montmorillonite
22	25-36	X	X	?	X	X-1	X-1	
37	8-22	X	X		?	X-5	X-5	X-1
38	27-53	X	X		X	X-5		X-1
39	17-35	X	X		X		X-5	X-1
40	31-137	X	X		X		X-5	X-1
42	41-60	X	X	X		?	?	X-1
45	40-76	X	X					X-1
46	20-45	X	X		X	X-4	X-5	X-1
48	55-89	X	X		X	X-2	X-3	X-1
50	11-30	X	X		X			X-1
53	23-45	X	X					X-1
54	17-30	X	X				X-5	X-1
55	40-120	X	X			X-1	X-1	?
58	34-72	X	X		X	X-5	X-5	X-1
63	14-27	X	X	?	X	X-5	X-5	X-1

X means the mineral appears in the less than 2 μ fraction. The clay minerals are ranked in order of abundance, with 1 being most abundant and 5 least abundant. Abundances are only estimates.

~~Figure 1~~ (Plots 1,2,3 wet; 1,2,3 dry)

BsC Soil



<5% Slope

Vegetation: Greasewood
Black Sage
Shadscale
Stipa
Indian Rice Grass

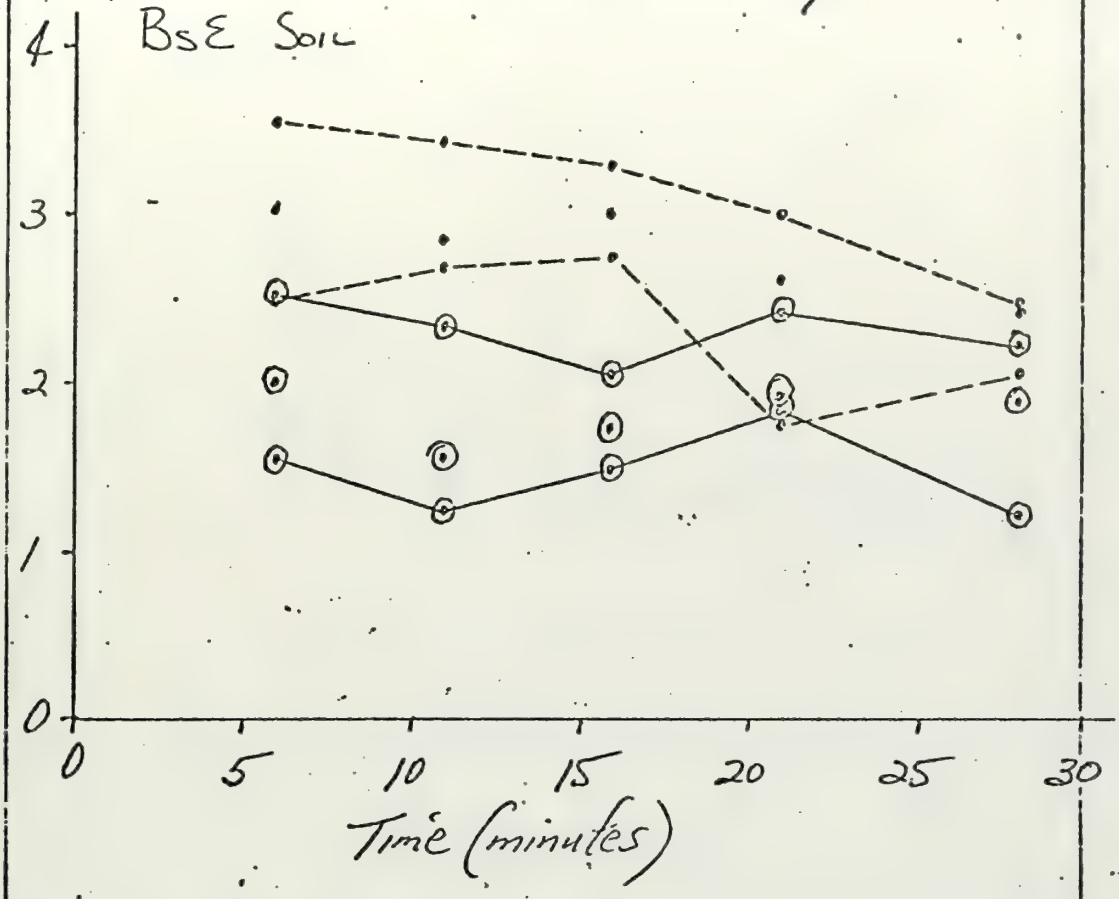
Antecedent Moisture: ——— Wet

- - - - - Dry

Average Percent Bare Soil: 28%

Sediment Yields: Dry $\bar{x}$ = 0.12 tons/acre.
Wet $\bar{x}$ = 0.16 tons/acre.

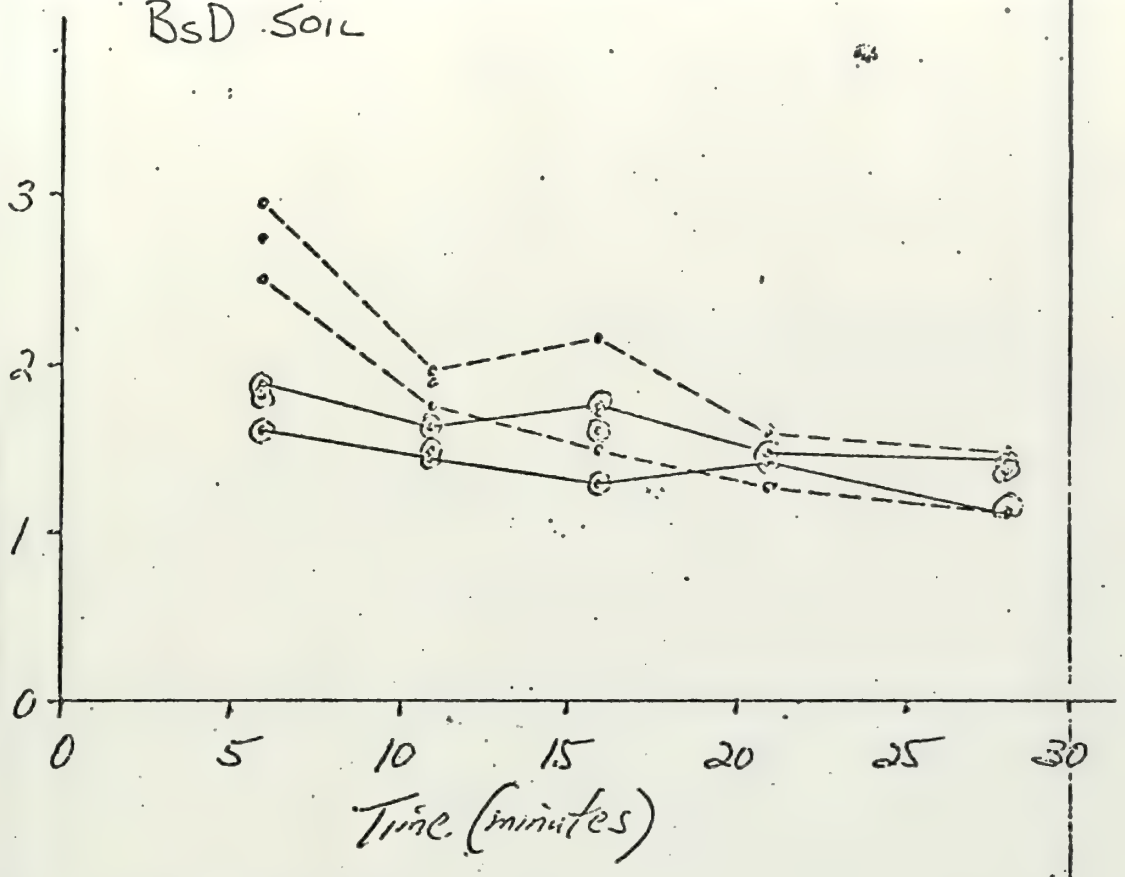
~~Figure 2~~ (Plots 4,5,6 wet; 4,5,6 dry)



60% Slope (Rocky)
Vegetation: Stipa
Blacksage
Antecedent Moisture: ——— Wet
------ Dry

Average Percent Bare Soil: 12%
Sediment Yields: Dry $\bar{x}$ = 0.46 tons/acre
Wet $\bar{x}$ = 1.06 tons/acre

~~Figure 5~~ (Plots 7,8,9 wet; 7,8,9 dry)



20-30% Slope

Vegetation: Greasewood
Shadscale
Blacksage
Stipa
Indian Rice Grass

Antecedent Moisture: ——— Wet

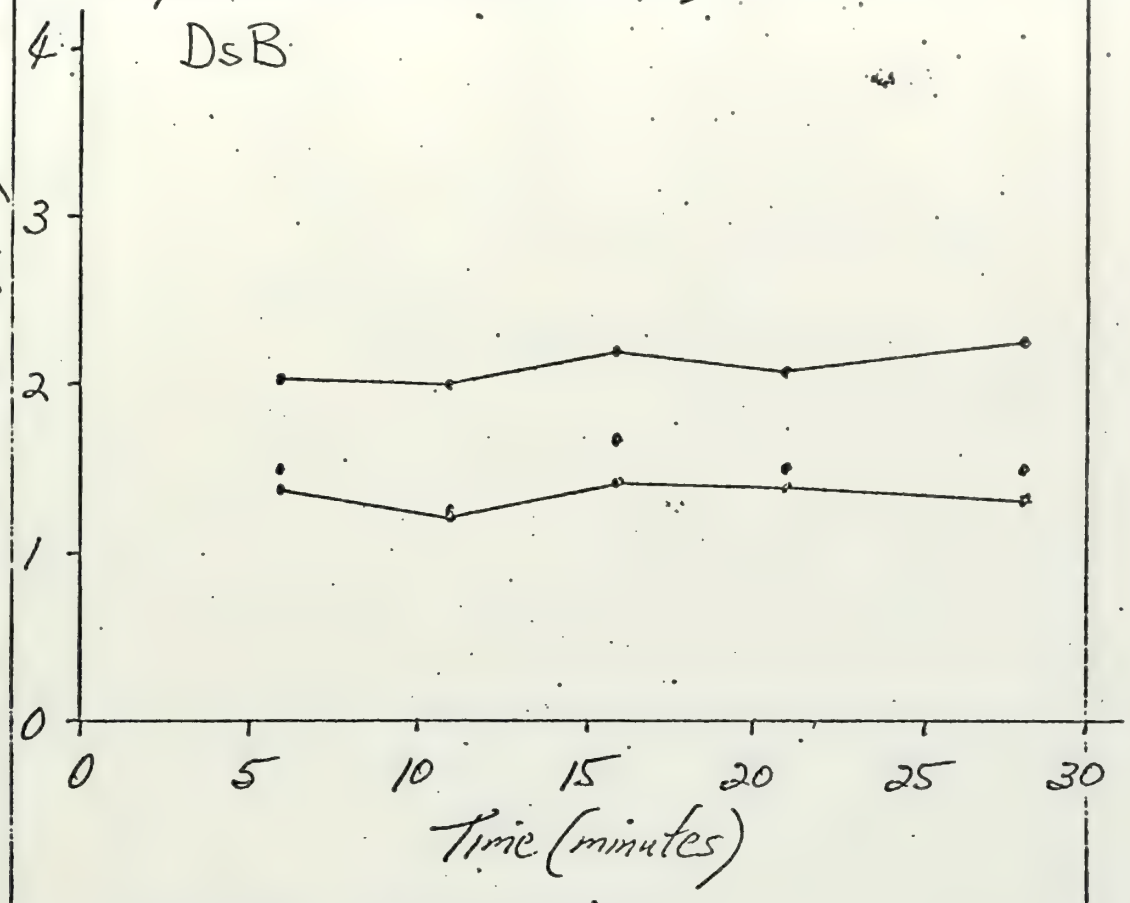
---. - Dry

Average Percent Bare Soil: 76%

Sediment Yields: Dry $\bar{x}$ = 0.20 tons/acre

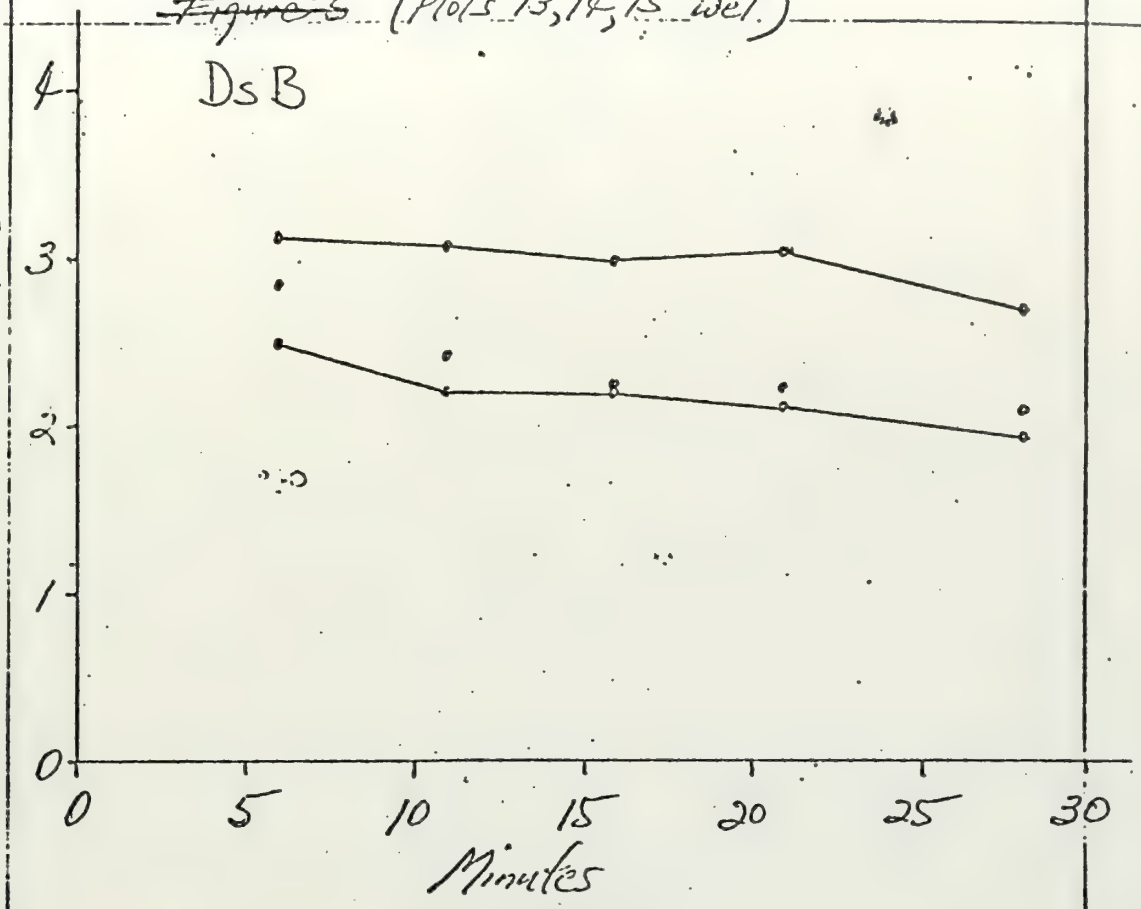
Wet $\bar{x}$ = 0.50 tons/acre

~~Figure 6~~ (Plots 10, 11, 12 wet)



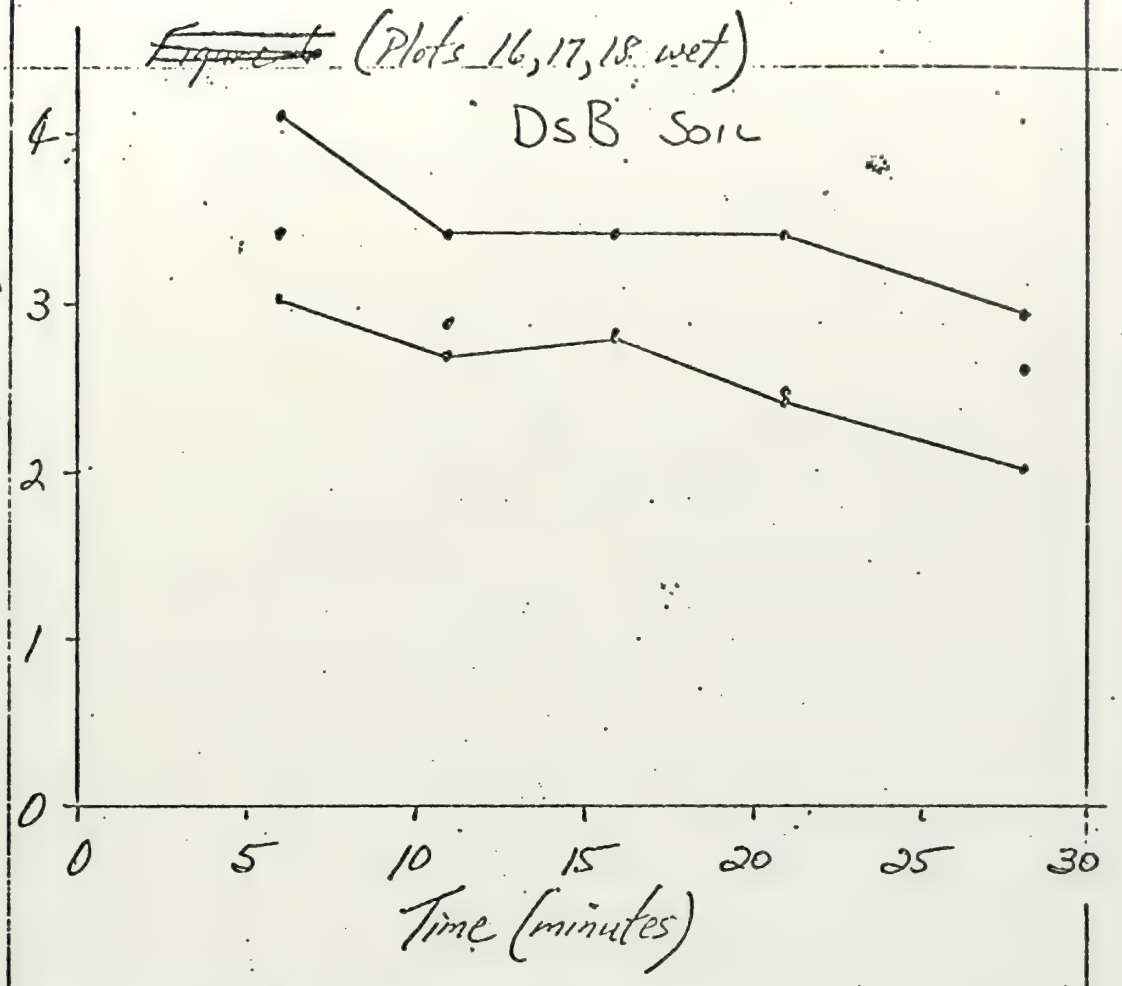
15% Slope (Alluvial Fan)
Vegetation: Blacksage
Greasewood
Tetradymia
Indian Rice Grass
Antecedent Moisture (Wet)
Average Percent Bare Soil: 21%
Sediment Yield: Wet $\bar{x}$ = 0.59 tons/acre

~~Figure 5~~ (Plots 13, 14, 15 wet)



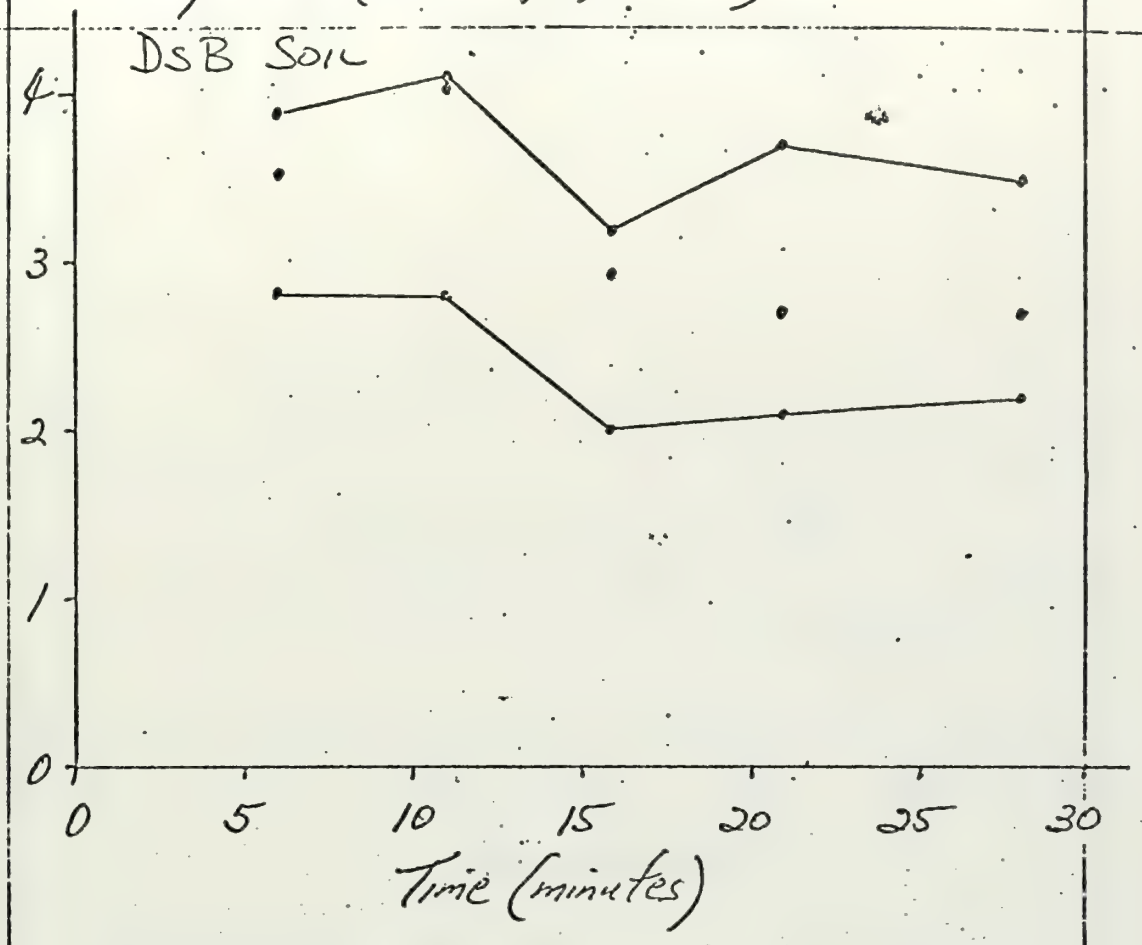
15% Slope (Alluvial fan)
Vegetation: Blacksage
Grease wood
Tetradenia
Indian Rice Grass
Antecedent Moisture (wet)
Average Percent Bare Soil: 19%
Sediment Yield: Wet $\bar{x}$ = 0.29 tons/acre

~~Figure~~ (Plots 16, 17, 18 wet)



0-5% Slope (Alluvial slope)
Vegetation: Greasewood
Sagebrush
Cheatgrass
Indian Rice Grass
Antecedent Moisture (wet)
Average Percent Bare Soil: 30%
Sediment Yield: Wet $\bar{x}$ = <.01 tons/acre

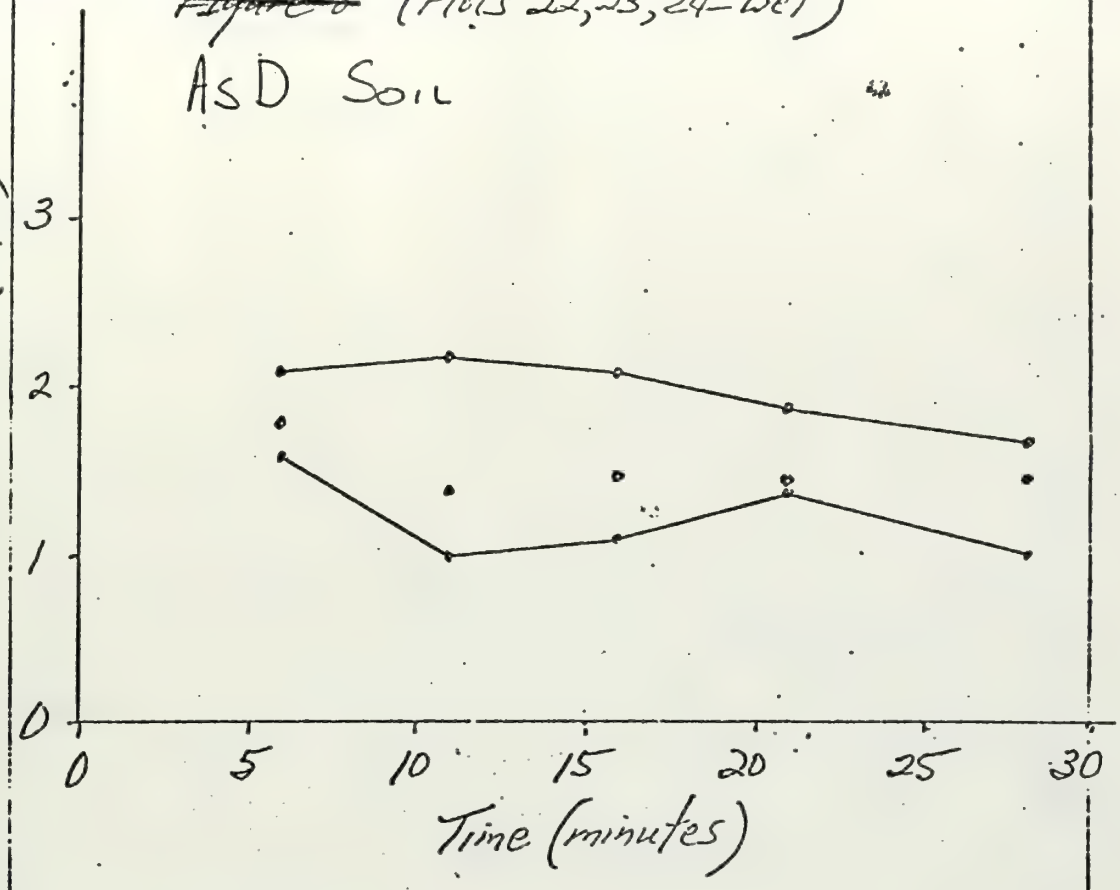
~~Figure 7~~ (Plots 19, 20, 21 wet)



0-5% Slope
Vegetation: Greasewood
Blacksage
Cheatgrass
Antecedent Moisture (wet)
Average Percent Bare Soil = 65%
Sediment Yield: wet $\bar{x}$ = 0.18 tons/acre

~~Figure 8~~ (Plots 22, 23, 24 – wet)

AsD Soil



30-40% Slope (Rocky)

Vegetation: Juniper
Black Sage
Shadscale

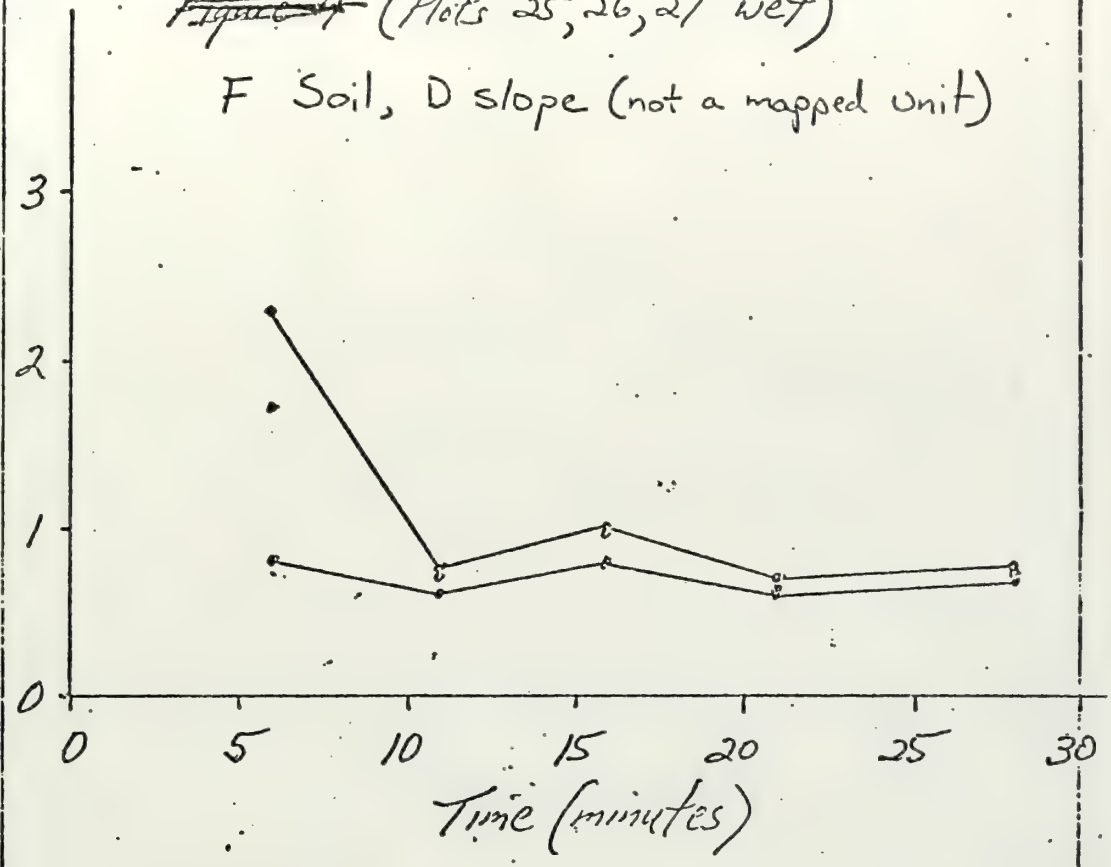
Antecedent Moisture (wet)

Average Percent Bare Soil: 60%

Sediment Yield: Wet $\bar{x}$ = 0.56 tons/acre

~~Figure 4~~ (Plots 25, 26, 27 wet)

F Soil, D slope (not a mapped unit)



30% Slope

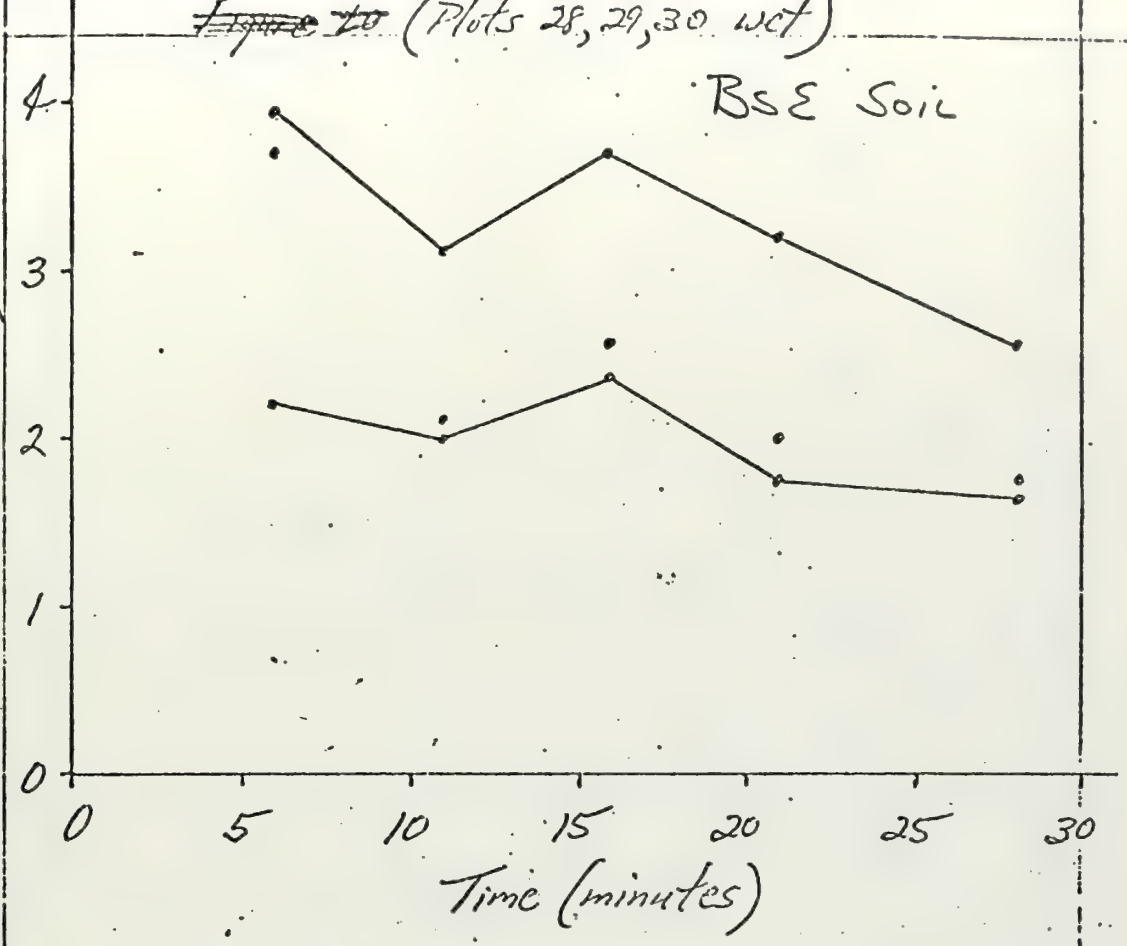
Vegetation: Juniper
Rabbitbrush
Shadscale

Antecedent Moisture (Wet)

Average Percent Bare Soil: 39%

Sediment Yield: Wet $\bar{x}$ = 0.69 tons/acre

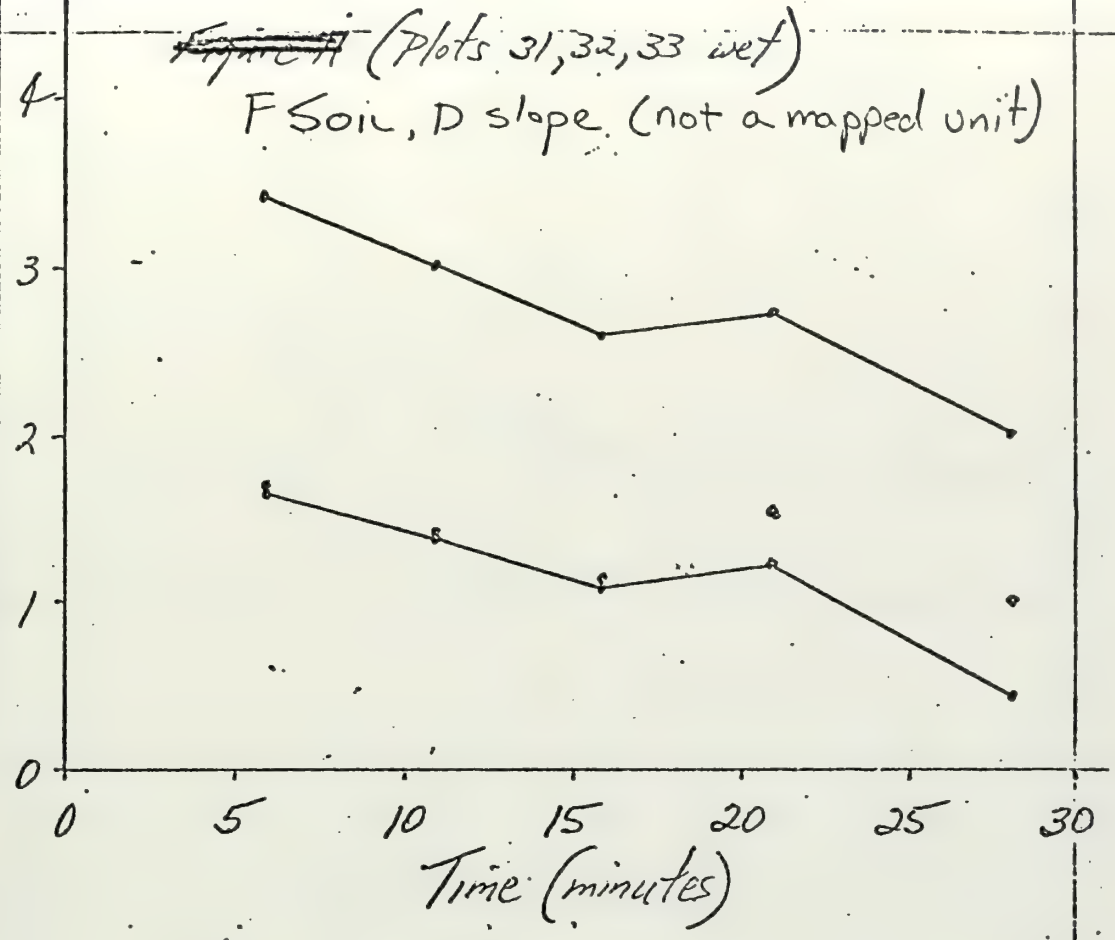
~~Figure 10~~ (Plots 28, 29, 30 wet)



80-90% Slope
Vegetation: Blacksage
Shadscale
Scattered Juniper
Antecedent Moisture (wet)
Average Percent Bare Soil: 43%
Sediment Yield: Wet $\bar{x}$ = 2.44 tons/acre

~~Typical~~ (Plots 31, 32, 33 wet)

F Soil, D slope (not a mapped unit)



40% Slope (Rocky)

Vegetation: Shadscale
Blacksage
Tetradymia
Cheatgrass

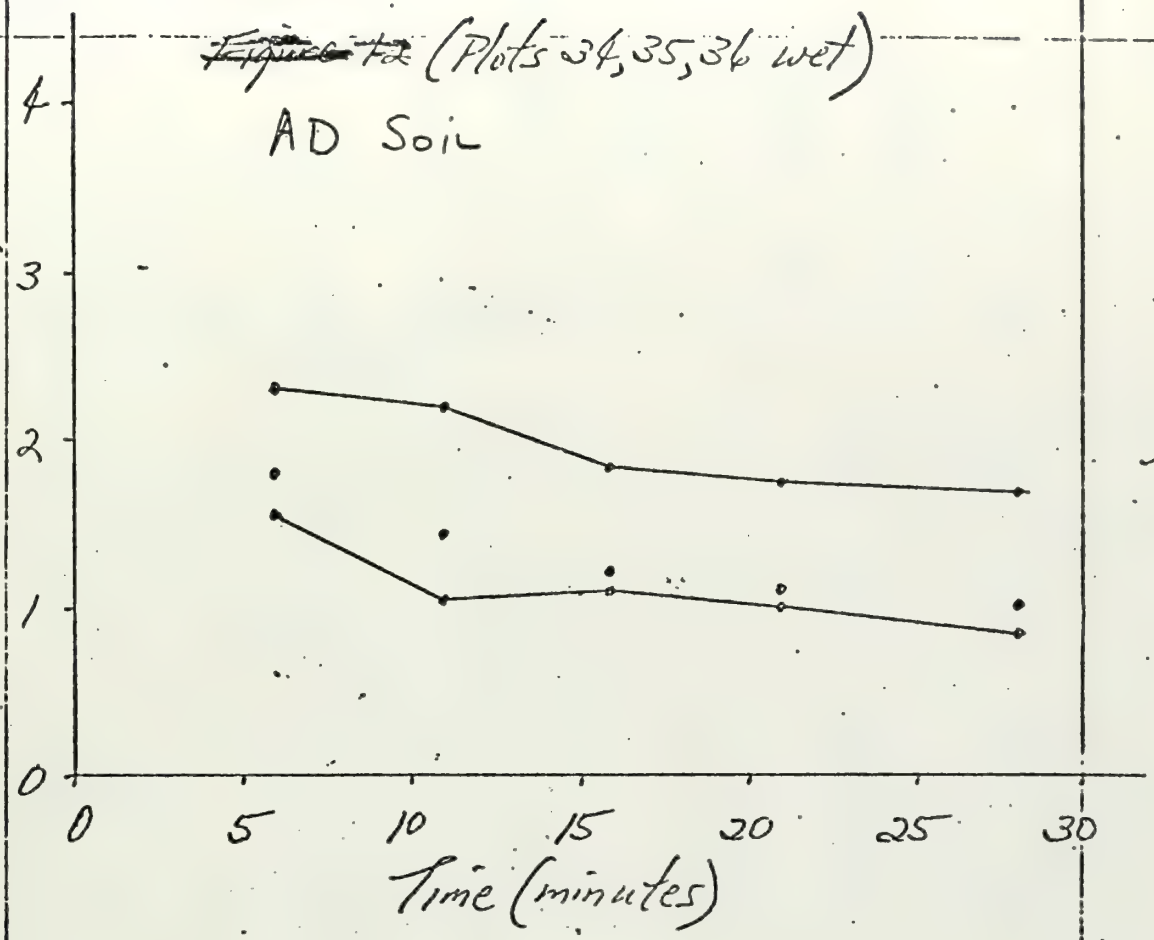
Antecedent Moisture (Wet)

Average Percent Bare Soil: 29%

Sediment Yield: Wet $\bar{x}$ = 0.24 tons/acre

~~Figure 12~~ (Plots 34, 35, 36 wet)

AD Soil



30% Slope (Rocky)

Vegetation: Blacksage
Shadscale
Tetradymia
Cheatgrass

Antecedent Moisture (wet)

Average Percent Bare Soil: 9%

Sediment Yield: wet $\bar{x}$ = 0.61 tons/acre

below

		Time Intervals (minutes)				
		3-8	8-13	13-18	18-23	23-28
Plot #1 (Dry)						
	cm/hr	7.67	8.15	6.63	6.93	5.59
Infiltration Rate	(in/hr)	3.02	3.21	2.61	2.73	2.18

Sediment yield = (0.20 tons per acre)
.45 gms/sq.m.

Plot #1 (Wet)						
	cm/hr	6.88	7.42	6.73	6.07	6.43
Infiltration Rate	(in/hr)	2.71	2.92	2.65	2.39	2.53

Sediment yield = 0.25 tons per acre)
.56 gm/sq.m.

		Time Intervals (minutes)				
		3-8.	8-13	13-18	18-23	23-28
Plot #2 (Dry)						
	cm/hr	8.69	8.10	7.49	7.09	6.71
Infiltration Rate	(in/hr)	3.42	3.19	2.95	2.79	2.64
Sediment yield =	(0.15 tons per acre)					
	.39 gm/sq.m.					
Plot #2 (Wet)						
	cm/hr	3.38	4.95	5.18	1.73	2.72
Infiltration Rate	(in/hr)	1.33	1.95	2.04	0.68	1.07
Sediment yield =	(0.20 tons per acre)					
	.45 gm/sq m					
Plot #3 (Dry)						
	cm/hr	9.88	7.09	6.73	7.44	8.26
Infiltration Rate	(in/hr)	3.89	2.79	2.95	2.93	3.25
Sediment yield =	(0.01 tons per acre)					
	.02 gm/sq.m.					
Plot #3 (Wet)						
	cm/hr	7.44	7.34	7.77	6.93	7.29
Infiltration Rate	(in/hr)	2.93	2.89	3.06	2.73	2.87
Sediment yield =	(0.03 tons per acre)					
	.07 gm/sq.m.					
Plot #4 (Dry)						
	cm/hr	7.67	7.26	7.72	7.62	6.17
Infiltration Rate	(in/hr)	3.02	2.86	3.04	3.00	2.43
Sediment yield =	(0.22 tons per acre)					
	.49 gm/sq.m.					
Plot #4 (Wet)						
	cm/hr	6.27	5.99	5.23	6.17	5.72
Infiltration Rate	(in/hr)	2.47	2.36	2.06	2.43	2.25
Sediment yield =	(0.42 tons per acre)					
	.99 gm/sq m					
Plot #5 (Dry)						
	cm/hr	9.04	8.71	6.99	6.65	6.30
Infiltration Rate	(in/hr)	3.56	3.43	2.75	2.62	2.48
Sediment yield =	(0.47 tons per acre)					
	1.05 gm/sq m					
Plot #5 (Wet)						
	cm/hr	3.91	3.20	3.86	4.75	3.10
Infiltration Rate	(in/hr)	1.54	1.26	1.52	1.87	1.22
Sediment yield =	(2.35 tons per acre)					
	5.27 gm/sq m					
Plot #6 (Dry)						
	cm/hr	8.81	6.91	8.38	4.47	5.23
Infiltration Rate	(in/hr)	3.47	2.72	3.30	1.76	2.06
Sediment yield =	(0.68 tons per acre)					
	1.52 gm/sq m					
Plot #6 (Wet)						
	cm/hr	5.11	4.01	4.47	4.98	4.88
Infiltration Rate	(in/hr)	2.01	1.58	1.76	1.96	1.92
Sediment yield =	(0.42 tons per acre)					
	.91 gm/sq m					

	Time Intervals (minutes)				
	3-8	8-13	13-18	18-23	23-28
Plot #7 (Dry)					
cm/hr	6.96	4.45	5.49	4.04	3.73
Infiltration rate (in/hr)	2.74	1.75	2.16	1.59	1.47
Sediment yield = (0.18 tons per acre) .40 gm/sq m					
Plot #7 (Wet)					
cm/hr	4.78	3.78	4.47	3.66	3.71
Infiltration Rate (in/hr)	1.88	1.49	1.76	1.44	1.46
Sediment yield = (0.38 tons per acre) .85 gm/sq m					
Plot #8 (Dry)					
cm/hr	6.38	4.75	4.39	3.78	3.45
Infiltration Rate (in/hr)	2.51	1.87	1.73	1.49	1.36
Sediment yield = (0.27 tons per acre) .61 gm/sq m					
Plot #8 (Wet)					
cm/hr	4.09	4.19	4.14	3.89	3.53
Infiltration Rate (in/hr)	1.61	1.65	1.63	1.53	1.39
Sediment yield = (0.79 tons per acre) 1.77 gm/sq m					
Plot #9 (Dry)					
cm/hr	7.54	4.95	3.81	3.25	2.87
Infiltration Rate (in/hr)	2.97	1.95	1.50	1.28	1.13
Sediment yield = (0.16 tons per acre) .36 gm/sq m					
Plot #9 (Wet)					
cm/hr	9.70	3.76	3.33	3.78	2.90
Infiltration Rate (in/hr)	1.85	1.48	1.31	1.49	1.14
Sediment yield = (0.33 tons per acre) .74 gm/sq m					
Plot #10 (Wet)					
cm/hr	3.73	3.23	3.63	3.53	3.89
Infiltration Rate (in/hr)	1.47	1.27	1.43	1.39	1.53
Sediment yield = (0.32 tons per acre) .72 gm/sq m					
Plot #11 (Wet)					
cm/hr	3.53	3.20	4.29	3.89	3.43
Infiltration Rate (in/hr)	1.39	1.26	1.69	1.51	1.35
Sediment yield = (0.67 tons per acre) 1.50 gm/sq m					
Plot #12 (Wet)					
cm/hr	5.23	5.08	5.59	5.36	5.79
Infiltration Rate (in/hr)	2.06	2.00	2.20	2.11	2.28
Sediment yield = (0.78 tons per acre) 1.75 gm/sq m					
Plot #13 (Wet)					
cm/hr	7.19	5.59	5.74	6.72	4.93
Infiltration Rate (in/hr)	2.83	2.20	2.26	2.25	1.94
Sediment yield = (0.34 tons per acre) .76 gm/sq m					

	Time Intervals (minutes)				
	3-8	8-13	13-18	18-23	23-28
Plot #14 (Wet)					
cm/hr	7.98	7.85	7.54	7.75	6.88
Infiltration Rate (in/hr)	3.14	3.09	2.97	3.05	2.71
Sediment yield = (0.25 tons per acre) .56 gm/sq m					
Plot #15 (Wet)					
cm/hr	6.32	6.15	5.59	5.38	5.26
Infiltration Rate (in/hr)	2.49	2.42	2.20	2.12	2.07
Sediment yield = (0.28 tons per acre) .63 gm/sq m					
Plot #16 (Wet)					
cm/hr	7.75	7.34	7.09	6.10	6.60
Infiltration Rate (in/hr)	3.05	2.89	2.79	2.40	2.60
Sediment yield = (0.01 tons per acre) .02 gm/sq m					
Plot #17 (Wet)					
cm/hr	10.39	8.69	8.59	8.69	7.44
Infiltration Rate (in/hr)	4.09	3.42	3.38	3.42	2.93
Sediment yield = (0.00 tons per acre) .00 gm/sq m					
Plot #18 (Wet)					
cm/hr	8.69	6.81	7.14	6.20	5.11
Infiltration Rate (in/hr)	3.42	2.68	2.81	2.44	2.01
Sediment yield = (0.00 tons per acre) .00 gm/sq m					
Plot #19 (Wet)					
cm/hr	8.99	10.49	7.39	6.88	6.81
Infiltration Rate (in/hr)	3.54	4.13	2.91	2.71	2.68
Sediment yield = (0.09 tons per acre) .20 gm/sq m					
Plot #20 (Wet)					
cm/hr	9.86	10.29	8.18	9.45	8.94
Infiltration Rate (in/hr)	3.88	4.05	3.22	3.72	3.52
Sediment yield = (0.17 tons per acre) .38 gm/sq m					
Plot #21 (Wet)					
cm/hr	7.16	7.11	5.11	538	5.64
Infiltration Rate (in/hr)	2.82	2.80	2.01	2.12	2.22
Sediment yield = (0.28 tons per acre) .63 gm/sq m					
Plot #22 (Wet)					
cm/hr	4.09	2.49	2.87	3.58	2.49
Infiltration Rate (in/hr)	1.61	0.98	1.13	1.41	0.98
Sediment yield = (0.86 tons per acre) 1.93 gm/sq m					
Plot #23 (Wet)					
cm/hr	4.52	3.51	3.89	3.68	3.73
Infiltration Rate (in/hr)	1.78	1.38	1.53	1.45	1.47
Sediment yield = (0.59 tons per acre) 1.32 gm/sq m					

	Time Intervals (minutes)				
	3-8	8-13	13-18	18-23	23-28
Plot #24 (Wet)					
cm/hr	5.38	5.59	5.36	4.90	4.37
Infiltration Rate (in/hr)	2.12	2.20	2.11	1.93	1.72
Sediment yield = (0.23 tons per acre) .52 gm/sq m					
Plot #25 (Wet)					
cm/hr	2.08	1.52	2.08	1.50	1.83
Infiltration Rate (in/hr)	0.82	0.60	0.82	0.59	0.72
Sediment yield = (0.69 tons per acre) 1.55 gm/sq m					
Plot #26 (Wet)					
cm/hr	5.87	1.91	2.57	1.83	1.88
Infiltration Rate (in/hr)	2.31	0.75	1.01	0.72	0.74
Sediment yield = (0.80 tons per acre) 1.79 gm/sq m					
Plot #27 (Wet)					
cm/hr	4.42	1.91	2.57	1.57	1.88
Infiltration Rate (in/hr)	1.74	0.75	1.01	.62	.74
Sediment yield = (0.57 tons/acre) 1.28 gm/sq m					
Plot #28 (Wet)					
cm/hr	9.35	7.98	9.35	8.71	6.50
Infiltration Rate (in/hr)	3.68	3.14	3.68	3.43	2.56
Sediment yield = (0.59 tons per acre) 1.32 gm/sq m					
Plot #29 (Wet)					
cm/hr	5.56	5.31	5.97	4.47	4.55
Infiltration Rate (in/hr)	2.19	2.09	2.35	1.76	1.79
Sediment yield = (4.72 tons per acre) 10.58 gm/sq m					
Plot #30 (Wet)					
cm/hr	10.06	5.03	6.30	5.11	4.19
Infiltration Rate (in/hr)	3.96	1.98	2.48	2.01	1.65
Sediment yield = (2.02 tons per acre) 4.53 gm/sq m					
Plot #31 (Wet)					
cm/hr	4.32	3.66	2.77	3.20	2.54
Infiltration Rate (in/hr)	1.70	1.44	1.09	1.26	1.00
Sediment yield = (0.03 tons per acre) .07 gm/sq m					
Plot #32 (Wet)					
cm/hr	8.66	7.72	6.58	6.96	5.28
Infiltration Rate (in/hr)	3.41	3.04	2.59	2.74	2.08
Sediment yield = (0.17 tons per acre) .38 gm/sq m					
Plot #33 (Wet					
cm/hr	4.14	3.48	2.79	3.91	1.09
Infiltration Rate (in/hr)	1.63	1.37	1.10	1.54	0.43
Sediment yield = (0.51 tons per acre) 1.14 gm/sq m					

	Time Intervals (minutes)				
	3-8	8-13	13-18	18-23	23-28
Plot #34 (Wet)					
cm/hr	5.92	5.59	4.70	4.45	4.37
Infiltration Rates (in/hr)	2.33	2.20	1.85	1.75	1.72
Sediment yield = (0.26 tons per acre) .58 gm/sq m					
Plot #35 (Wet)					
cm/hr	3.94	2.77	2.79	2.49	2.16
Infiltration Rate (in/hr)	1.55	1.09	1.10	0.98	0.85
Sediment yield = (1.14 tons per acre) 2.55 gm/sq m					
Plot #36 (Wet)					
cm/hr	4.55	3.68	3.10	2.84	2.62
Infiltration Rate (in/hr)	1.79	1.45	1.22	1.12	1.03
Sediment yield = (0.43 tons per acre) .96 gm/sq m					

CUSTOMER AEROVIRONMENT INC.
ATTENTION Dr. Ivar Tombach, Director of Environmental Programs
ADDRESS 145 Vista Avenue
CITY Pasadena, California 91107
S.O. NO. 3051

REPORT OF ANALYSIS

TYPE OF ANALYSIS DETERMINATION of GAMMA ISOTOPIC by GeLi in SOIL SAMPLES
CUSTOMER ORDER NUMBER 45327
SAMPLES RECEIVED 12-19-74

Identification:	#39 0-4	#39 17-35	#40 0-6	#40 31-137
Dry Weight (g):	2728	2546	2542	2960

Nuclide Observed	pCi/g (Dry)			
K-40	18 ± 2	11 ± 3	20 ± 3	16 ± 2
Bi-214	0.73 ± 0.29	0.49 ± 0.29	0.79 ± 0.36	0.85 ± 0.31
Tl-208	0.36 ± 0.11	0.19 ± 0.11	0.30 ± 0.12	0.30 ± 0.12
Pb-214	0.65 ± 0.27	0.71 ± 0.24	0.78 ± 0.30	0.74 ± 0.27
Ac-228	0.92 ± 0.52	0.79 ± 0.50	< 0.68	0.94 ± 0.50
Pb-212	1.5 ± 0.3	1.2 ± 0.3	1.0 ± 0.3	1.0 ± 0.3
Cs-137	0.98 ± 0.14	< 0.12	1.6 ± 0.2	0.09 ± 0.08

TYPE OF ANALYSIS DETERMINATION of RADIUM-226 & STRONTIUM-90 in SOIL SAMPLES

Sample Identification	Total Dry Weight (g)	pCi/g (Dry) Ra-226	pCi/g (Dry) Sr-90
#39 0-4	2728	0.17 ± 0.01	0.52 ± 0.02
#39 17-35	2545	0.66 ± 0.03	0.00 ± 0.01
#40 0-6	2542	0.87 ± 0.03	0.48 ± 0.02
#40 31-137	2959	0.66 ± 0.03	0.02 ± 0.01

☐ REPORTED VIA TELEPHONE
☐ REPORTED VIA TWX

EBERLINE INSTRUMENT CORPORATION
P.O. BOX 3674 ALBUQUERQUE, NEW MEXICO 87110

APPROVED BY Ernest A. Sanchez, Manager
Albuquerque Laboratory
DATE 03-13-75

B. TERRESTRIAL VERTEBRATES

1. RESULTS OF FLUSHING TRANSECT SAMPLING

on or within 1.6 km (1 mile) of Utah Oil Shale Tracts, October 1975. X = herptile observed. G = greasewood, J = juniper, S = shadscale, R = riparian.

	October 1975			
	VEGETATION TYPE			
REPTILE (ORDER / SPECIES)	G	J	S	R
Squamata				
Eastern Fence Lizard	–	X	–	X
Sagebrush Lizard	X	X	X	–
Short-horned Lizard	–	–	X	–
Tree Lizard	–	X	–	–
Side-blotched Lizard	X	X	X	X
Western Whiptail	–	X	–	–
Striped Whipsnake	–	X	X	–
Gopher Snake	X	X	–	X
Western Terrestrial Garter Snake	–	–	–	X
Western Rattlesnake	X	–	–	–

Table 2. Avian species on or within 1.6 km (1 mile) of Utah Oil Shale Tracts, October 1975. X = bird observed. G = greasewood, J = juniper, S = shadscale, R = riparian.

BIRD (ORDER/SPECIES)	October 1975 VEGETATION TYPE			
	G	J	S	R
Falconiformes				
Marsh Hawk	X	–	X	–
Cooper's Hawk	–	–	–	X
Red-tailed Hawk	X	–	X	–
Golden Eagle	X	X	X	–
Prairie Falcon	X	X	X	X
American Kestrel	X	X	X	–
Gruiformes				
Sandhill Crane	–	–	–	X
Columbiformes				
Mourning Dove	X	X	X	X
Strigiformes				
Great Horned Owl	–	–	–	X
Coraciiformes				
Belted Kingfisher	–	–	–	X
Piciformes				
Downy Woodpecker	–	–	–	X
Yellow-bellied Sapsucker	–	–	–	X
Common Flicker	–	X	–	X
Passeriformes				
Horned Lark	X	X	X	X
Barn Swallow	–	–	X	–
Black-billed Magpie	X	X	X	X
Common Raven	–	–	X	–
Clark's Nutcracker	–	X	–	–
Pinyon Jay	X	X	–	–
Plain Titmouse	X	X	–	–
Black-capped Chickadee	–	–	–	X
Common Bushtit	–	?	–	X
Rock Wren	X	X	X	–

TABLE 2 (CONTINUED).
(Page 2)

BIRD (ORDER / SPECIES)	October 1975 VEGETATION TYPE			
	G	J	S	R
Passeriformes (CONTINUED)				
Sage Thrasher	X	-	X	-
Townsend's Solitaire	-	-	-	X
Swainson's Thrush	-	-	-	X
American Robin	-	-	-	X
Mountain Bluebird	X	X	X	-
Ruby-crowned Kinglet	-	X	-	X
Loggerhead Shrike	X	-	X	-
Western Meadowlark	X	-	X	X
Brewer's Blackbird	-	-	-	X
House Finch	-	X	-	-
Pine Siskin	-	-	-	X
Lark Sparrow	X	X	-	-
White-crowned Sparrow	X	X	-	X
Tree Sparrow	-	-	-	X
Chipping Sparrow	X	X	-	X
Dark-eyed Junco	X	X	-	X
Sage Sparrow	X	X	X	X
Song Sparrow	-	-	-	X
Rufous-sided Towhee	X	-	-	X

Observations on or within 1.6 km (1 mile) of Utah Oil Shale Tracts, October 1975. X = Mammal observed. G = greasewood, J = juniper, S = shadescale, R = riparian.

MAMMAL (ORDER / SPECIES)	October 1975 VEGETATION TYPE			
	G	J	S	R
Chiroptera				
Bat (unidentified species)	X	X	-	-
Carnivora				
Badger	-	-	-	X
Coyote	-	X	-	X
Rodentia				
Whitetail Antelope Squirrel	X	-	X	-
Golden-mantled Squirrel	X	X	X	X
Colorado Chipmunk	-	X	-	X
Whitetail Prairie Dog	-	-	X	-
Apache Pocket Mouse	X	X	-	X
Ord Kangaroo Rat	X	-	-	-
Deer Mouse	X	X	-	X
Pinyon Mouse	-	X	-	-
Desert Woodrat	X	X	-	-
Porcupine	-	X	-	X
Lagomorpha				
Desert Cottontail	X	X	X	X
Artiodactyla				
Mule Deer	X	X	X	X
Domestic Cattle	-	-	-	X

(Page 1)

TABLE 4. [See title opposite]

SAMPLING SITE*	HERPTILE (SPECIES)	DISTANCE (m) 0	1	2	3	4	5	>5	NO. SAMPLES	DENSITY NUMBER OBSERVED	NUMBER PER HA	BIOMASS (kg) OBSERVED	BIOMASS PER HA
PG (1 transect only)	(NONE)								0	0			
SG (1 transects only)	Sagebrush Lizard	2							2	2			
	Side-blotched Lizard	2							2	2			
OG	Sagebrush Lizard	3							3	3			
	Side-blotched Lizard	3							3	3			
PJ (1 transects only)	Eastern Fence Lizard	3							3	3			
	Sagebrush Lizard	4							4	4			
	Tree Lizard	1							1	1			
	Side-blotched Lizard	5							5	5			
	Western Whiptail	1							1	—			
	Unidentified, lizard	2	1						3	3			
SJ	Sagebrush Lizard	3							3	3			
	Side-blotched Lizard	3							3	3			
OJ (4 transects only)	Sagebrush Lizard	2							2	2			
	Side-blotched Lizard	2	1				1		4	4			
PR (1 transects only)	Side-blotched Lizard				1				1	1			
OR (1 transects only)	Eastern Fence Lizard	1							1	1			
	Side-blotched Lizard	1							1	1			

TABLE . Herptile numbers, estimated wet
Weight biomass, and distance from trans
line on sampling sites during October 197
sampling period. PG = primary greasewood
SG = secondary greasewood, OG = off-tract greasew
PJ = primary juniper, SJ = secondary junipe
OJ = off-tract juniper, PR = primary ripari
OR = off-tract riparian.

* No transects were walked on the follow
sampling sites due to inclement weathe
primary shadscale, secondary shadscale,
off-tract shadscale, riparian greasewood

(Page 1) TABLE 5. [See title opposite]

SAMPLING SITE	BIRD (SPECIES)	DISTANCE (m) 0-5	6-10	11-15	16-20	21-25	26-30	31-40	41-50	51-75	76-100	>100	NO. SAMPLES	DENSITY NUMBER OBSERVED	NUMBER PER HA	BIOMASS (kg) OBSERVED	BIOMASS PER HA
PG	American Kestrel	1											1	1			
	Black-billed Magpie	1						1		2			4	4			
	Pinyon Jay	96		3									5	99			
	Plain Titmouse					1		1					2	2			
	White-crowned Sparrow			2									1	2			
	Dark-eyed Junco	2		2									2	4			
	Sage Sparrow			1									1	1			
SG	Golden Eagle											1	1	1			
	Horned Lark	9								6			2	15			
	Black-billed Magpie											1	1	1			
	Rock Wren				1	1		4					4	6			
	Mountain Bluebird				1								1	1			
	Western Meadowlark							1					1	1			
	Sage Sparrow			2	1			2					3	5			
	Unidentified, Passeriformes	1											1	1			
OG	Golden Eagle	1									1		2	2			
	Horned Lark			5									1	5			
	Lark Sparrow	5											1	5			
	Chipping Sparrow					1							1	1			
	Sage Sparrow	1	1			1							3	3			
	Rufous-sided Towhee						1						1	1			
	Unidentified, Fringillidae	2											1	2			

TABLE . . Bird numbers, estimated wet weight biomas and distance from transect li on sampling sites during October 1975 sampling perio

PG = primary greasewood,
SG = secondary greasewood,
OG = off-tract greasewood,
PJ = primary juniper,
SJ = secondary juniper,
OJ = off-tract juniper,
PS = primary shadscale,
SS = secondary shadscale,
OS = off-tract shadscale,
PR = primary riparian,
OR = off-tract riparian,
RG = riparian greasewood.

age 2) TABLE 5 (CONTINUED).

MPLING SITE	BIRD (SPECIES)	DISTANCE (m) 0-5	6-10	11-15	16-20	21-25	26-30	31-40	41-50	51-75	76-100	>100	NO. SAMPLES	DENSITY NUMBER OBSERVED	NUMBER PER HA	BIOMASS (kg) OBSERVED	BIOMASS PER HA
PJ	Horned Lark	3											1	3			
	Black-billed Magpie						1	1					2	2			
	Clark's Nutcracker	6											1	6			
	Pinyon Jay	1	9		2				4	1			5	17			
	Plain Titmouse		1										1	1			
	Rock Wren				2				1				2	3			
	Mountain Bluebird	2								1			3	3			
	House Finch	1											1	1			
	Dark-eyed Junco	2											1	2			
	Unidentified, Passeriformes	2											2	2			
SJ	Mountain Bluebird	5		3									2	8			
	Lark Sparrow			1									1	1			
	Chipping Sparrow					3							1	3			
	Unidentified, Fringillidae	1											1	1			
CJ	Pinyon Jay			4		10							2	14			
	Plain Titmouse		1	1									2	2			
	Chipping Sparrow					1							1	1			
	Dark-eyed Junco						2						1	2			
	Sage Sparrow	1											1	1			
	Unidentified, Fringillidae	3											1	3			
PS	Marsh Hawk											1	1	1			
	Horned Lark	61											4	61			
	Barn Swallow	4											1	4			
	Rock Wren	1											1	1			
	Loggerhead Shrike						1						1	1			

age 3) TABLE 5 (CONTINUED).

SAMPLING SITE	BIRD (SPECIES)	DISTANCE (m) 0-5	6-10	11-15	16-20	21-25	26-30	31-40	41-50	51-75	76-100	>100	NO. SAMPLES	DENSITY NUMBER OBSERVED	NUMBER PER HA	BIOMASS(kg) OBSERVED	BIOMASS(kg) PER HA
SS	Horned Lark	24											3	24			
	Western Meadowlark	1	1					2		3			5	7			
	Sage Sparrow	1	2	–									2	3			
CS	Horned Lark	29											3	29			
	Loggerhead Shrike					1							1	1			
	Western Meadowlark			2									2	2			
	Sage Sparrow	4	2										3	6			
PR	Cooper's Hawk	1						1					2	2			
	Great Horned Owl						1						1	1			
	Downy Woodpecker						1						1	1			
	Yellow-bellied Sapsucker						1						1	1			
	Common Flicker			2									2	2			
	Horned Lark	22											1	22			
	Black-billed Magpie	4					1						5	5			
	Townsend's Solitaire		1										1	1			
	American Robin	1											1	1			
	Ruby-crowned Kinglet	1											1	1			
	Brewer's Blackbird	1											1	1			
	Dark-eyed Junco	5											1	5			
	Rufous-sided Towhee	5		1									3	6			
	Unidentified, Fringillidae	1	1										2	2			
	Unidentified, Passeriformes	2	1						1				4	4			

(Page 4) TABLE 5 (CONTINUED).

SAMPLING SITE	BIRD (SPECIES)	DISTANCE (m) 0-5	6-10	11-15	16-20	21-25	26-30	31-40	41-50	51-75	76-100	>100	NO. SAMPLES	DENSITY NUMBER OBSERVED	NUMBER PER HA	BIOMASS (kg) OBSERVED	BIOMASS PER HA
OR	Mourning Dove	1		2	1		1						5	5			
	Downy Woodpecker	1											1	1			
	Yellow-bellied Sapsucker		2	3	1	1							7	7			
	Common Flicker					1	1						2	2			
	Black-billed Magpie	3							1				3	4			
	Swainson's Thrush		1										1	1			
	White-crowned Sparrow	2											2	2			
	Chipping Sparrow	1											1	1			
	Dark-eyed Junco				1								1	1			
	Rufous-sided Towhee	1	2				1						4	4			
	Unidentified, Fringillidae	2	1		1								3	4			
	Unidentified, Passeriformes	2											2	2			
RG	Common Flicker					1	1						2	2			
	Common Bushtit	7	9										2	16			
	Townsend's Solitaire			3									1	3			
	Pine Siskin		1										1	1			
	White-crowned Sparrow	3		2									4	5			
	Tree Sparrow	1											1	1			
	Chipping Sparrow	1	1										2	2			
	Dark-eyed Junco	28	10	4									8	42			
	Sage Sparrow	4	2	2									5	8			
	Rufous-sided Towhee		1										1	1			
	Unidentified, Passeriformes	10											1	10			

(page 1)

TABLE 6. [See title opposite]

SAMPLING SITE	MAMMAL (SPECIES)	DISTANCE (m) 0-5	6-10	11-15	16-20	21-25	26-30	31-40	41-50	51-75	76-100	>100	NO. SAMPLES	DENSITY NUMBER OBSERVED	NUMBER PER HA	BIOMASS(kg) OBSERVED	BIOMASS(kg) PER HA
PG	Desert Cottontail					1							1	1			
SG	Whitetail Antelope Squirrel	1			4	1		2					8	8			
	Desert Cottontail				1			1					2	2			
OG	Whitetail Antelope Squirrel						1		1				2	2			
	Desert Cottontail	7		3		3	3	1	1				18	18			
PJ	Desert Cottontail	7	3	1									11	11			
SJ	Desert Cottontail	2	1	2		1		2	2				10	10			
	Unidentified, Chiroptera	1											1	1			
OJ	Colorado Chipmunk			2									2	2			
	Desert Cottontail								3				3	3			
	Unidentified, Eutamias									1			1	1			
PS	Whitetail Antelope Squirrel		1					1		1			3	3			
	Desert Cottontail	4		1	1								6	6			
SS	Desert Cottontail	4											4	4			
OS	Whitetail Antelope Squirrel			1									1	1			
PR	Mule Deer	1			3		1	2	3	3			13	13			
	Domestic Cattle	3		2	5	1	1	4	1	9	4	1	31	31			

TABLE ... Mammal numbers, estimated wet weight biom... and distance from transect l... on sampling sites during October 1975 sampling perio...

PG = primary greasewood,
SG = secondary greasewood,
OG = off-tract greasewood,
PJ = primary juniper,
SJ = secondary juniper,
OJ = off-tract juniper,
PS = primary shadscale,
SS = secondary shadscale,
OS = off-tract shadscale,
PR = primary riparian,
OR = off-tract riparian,
RG = riparian greasewood.

ge 2)

TABLE 6 (CONTINUED).

SAMPLING SITE	MAMMAL (SPECIES)	DISTANCE (m) 0-5	6-10	11-15	16-20	21-25	26-30	31-40	41-50	51-75	76-100	>100	NO. SAMPLES	DENSITY NUMBER OBSERVED	NUMBER PER HA	BIOMASS (kg) OBSERVED	BIOMASS PER HA
OR	Desert Cottontail			1									1	1			
	Mule Deer	1						1					2	2			
	Domestic Cattle	7		3	2	5	3	4					24	24			
RG	Desert Cottontail	7		4	4	3	1	2	2				23	23			

TABLE 7. [See title opposite]

ge1) MPLING SITE*	RODENT (SPECIES)	NUMBER CAPTURED DAY 1	2	3	4	5	NUMBER CAPTURED FIRST TIME DAY 1	2	3	4	5	DENSITY NUMBER OBSERVED	NUMBER PER HA	BIOMASS (kg) OBSERVED	BIOMASS (kg) PER HA
PG (4 trap ghts only)	Apache Pocket Mouse	2	-	-	-	-	2	-	-	-	-	2			
	Ord Kangaroo Rat	3	-	-	-	-	3	-	-	-	-	3			
	Deer Mouse	4	-	-	-	-	4	-	-	-	-	4			
SG (+ trap ght only)	Apache Pocket Mouse	3	-	-	-	-	3	-	-	-	-	3			
	Deer Mouse	4	-	-	-	-	4	-	-	-	-	4			
	Desert Woodrat	2	-	-	-	-	2	-	-	-	-	2			
OG	Apache Pocket Mouse	0	5	5	9	5	0	5	3	4	0	12			
	Deer Mouse	6	7	8	6	6	6	2	2	1	2	13			
	Desert Woodrat	1	1	2	1	2	1	0	1	0	0	2			
PJ (4 trap ghts only)	Apache Pocket Mouse	2	-	-	-	-	2	-	-	-	-	2			
	Deer Mouse	3	-	-	-	-	3	-	-	-	-	3			
	Pinyon Mouse	2	-	-	-	-	2	-	-	-	-	2			
	Desert Woodrat	2	-	-	-	-	2	-	-	-	-	2			
SJ	Colorado Chipmunk	1	0	0	0	0	1	0	0	0	0	1			
	Apache Pocket Mouse	3	4	5	5	4	3	1	2	1	0	7			
	Deer Mouse	2	2	2	2	2	2	1	1	0	0	4			
	Pinyon Mouse	0	0	0	0	1	0	0	0	0	1	1			
	Desert Woodrat	2	3	3	3	3	2	1	1	0	0	4			
OJ (4 trap hts only)	Apache Pocket Mouse	1	-	-	-	-	1	-	-	-	-	1			
	Deer Mouse	3	-	-	-	-	3	-	-	-	-	3			
	Desert Woodrat	1	-	-	-	-	1	-	-	-	-	1			
PR	Deer Mouse	3	3	3	4	5	3	0	1	1	1	6			

TABLE . Number of rodents capture
within rodent trapping transects on
sampling sites during October 197
sampling period (24 Sherman live tr
for 5 days = 120 trap nights per
sampling site, except where otherwise
indicated). PG = primary greaswood
SG = secondary greaswood, OG = off-tr
greaswood, PJ = primary juniper,
SJ = secondary juniper, OJ = off-tract
juniper, PR = primary riparian,
OR = off-tract riparian.

* No trapping was done on the followi
sampling sites due to inclement weath
primary shadscale, secondary shadsca
off-tract shadscale, riparian greasw

ge 2)

TABLE 7 (CONTINUED).

MPLING SITE	RODENT (SPECIES)	NUMBER CAPTURED DAY 1	2	3	4	5	NUMBER CAPTURED FIRST TIME DAY 1	2	3	4	5	DENSITY NUMBER OBSERVED	NUMBER PER HA	BIOMASS(g) OBSERVED	BIOMASS(g) PER HA
CR	Apache Pocket Mouse	0	0	1	2	1	0	0	1	1	0	2			
	Deer Mouse	1	0	2	2	2	1	0	2	1	1	5			

B. TERRESTRIAL VERTEBRATES
2. LARGE MAMMAL MONITORING

DATE	LOCATION AND VEGETATION TYPE	SIGHTING TYPE	NUMBER & CLASSIFICATION	COMMENTS
9/2	¼ mile upstream from mouth of Asphalt Wash Sagebrush-Shadscale	Radio	.09	
9/2	Junction of Wagon Hound Road & Road to A-3. Juniper	Ocular	Two does & Three fawns.	
	¼ mile South of A-3 along road. Sagebrush-Shadscale	Ocular	One buck (2 point).	
9/3	Riparian area to mouth of Hell Hole Canyon Riparian	Ocular	One doe and one fawn.	
	½ mile upstream from mouth of Cowboy Canyon Riparian	Radio	.05	Signal poor
9/8	Under Evac. pipe-line. Riparian	Ocular	Three does & two fawns.	
	Under Evac. pipe-line Riparian	Radio	.06	Signal poor

DATE	LOCATION AND VEGETATION TYPE	SIGHTING TYPE	NUMBER & CLASSIFICATION	COMMENTS
9/17	North side of river at mouth of Asphalt. Riparian	Ocular	Two does, two fawns & one buck (2 point).	
9/29	Mouth of Southam Canyon Riparian	Ocular	One doe & one fawn.	

DATE	LOCATION AND VEGETATION TYPE	SIGHTING TYPE	NUMBER & CLASSIFICATION	COMMENTS
10/14	½ mile up Wagon Hound Canyon from Bridge. Sagebrush-Shadscale	Ocular	Two does & Two fawns.	
	½ mile above White-river Bridge. Riparian	Ocular	Four does & Three fawns One doe & 0 fawn	No collars
10/17	Evac. Creek Bridge Riparian	Ocular	One doe & One fawn Three does & Two fawns	No collars
10/21	½ mile North of mouth of Southam in Canyon. Sagebrush-shadscale.	Ocular	Five does & four fawns	No collars
10/23	½ mile upsteam from Evac. Creek Bridge Sagebrush-Shadscale.	Ocular	Two does & Three fawns One doe & 0 fawns Two does & Two fawns	No collars. Seen in mixed Riparian & Sagebrush-Shadscale Habitats.
10/25	¼ mile-½ mile up Evac. Creek from mouth. Riparian	Ocular	One doe & Three fawns One doe & One fawn Two does & One fawns	No collars
10/28	White River from Evac. pipeline to Hell Hole Mouth. Riparian	Ocular	Two does & Three fawns Two does & Two fawns Three does & Two fawns One doe & 0 fawn One doe & 1 fawn One doe & 1 fawn One doe & 1 fawn One doe & 0 fawn.	No collars

APPENDIX LI

DATE	LOCATION AND VEGETATION TYPE	SIGHTING TYPE	NUMBER & CLASSIFICATION	COMMENTS
10/24	Mouth of Cowboy Canyon Riparian	Radio	.05	
	1/8 mile above Evac. pipeline Riparian	Radio	.06	
10/27	½ mile upstream from of Asphalt . Riparian	Radio	.09	
10/28	½ mile N. W. of Southam Mouth Sagebrush-Shadscale	Radio	.07	Weak signal in Canyon
10/30	½ mile above Evac. pipeline. Riparian	Radio	.06	
	½ mile downstream from mouth of Cowboy. Riparian	Radio	.05	

DATE	LOCATION AND VEGETATION TYPE	SIGHTING TYPE	NUMBER & CLASSIFICATION	COMMENTS
10/30	Duck Rock Sagebrush-shadscale.	Ocular	One doe & one fawn	

DATE	LOCATION AND VEGETATION TYPE	SIGHTING TYPE	NUMBER & CLASSIFICATION	COMMENTS
11/4	Mouth of Evac. Creek Riparian	Ocular	3 does 2 fawns	
	Mouth of Cowboy Canyon on North side Riparian	Ocular	7 unclassified	
	Ignacio Riparian	Ocular	2 does 2 fawns	
	North across river from X-2 Riparian	Ocular	3 unclassified	
11/5	Mouth of Asphalt Wash Riparian	Ocular	4 unclassified	
	A-11 Juniper	Ocular	5 does 3 fawns	
	½ mile above Ignacio on North side of river Riparian	Ocular	3 does 3 fawns	

DATE	LOCATION AND VEGETATION TYPE	SIGHTING TYPE	NUMBER & CLASSIFICATION	COMMENTS
11/17	½ mile up Evac. Creek from mouth Riparian	Ocular	3 does 2 fawns	
	Evac. bridge Riparian	Ocular	2 does 2 fawns 1 buck	
11/19	Evac. bridge Riparian	Ocular	3 does 2 fawns	
11/25	Under Evac. pipeline Riparian	Ocular	5 unclassified	
	1/8 mile downstream from mouth of Cowboy Canyon on North side of river. Riparian	Ocular	6 unclassified	

DATE	LOCATION AND VEGETATION TYPE	SIGHTING TYPE	NUMBER & CLASSIFICATION	COMMENTS
11/4	½ mile above Evac. pipeline Riparian	Radio	.06	
	South side of river from Cowboy mouth Riparian	Radio	.05	
	Across river from X-2. Riparian	Radio	.02	
11/5	Under Evac. pipeline Riparian	Radio	.06	
	½ mile due north of S-12 Sage-Shadscale	Radio	.09	
11/12	Under Evac. pipeline. Riparian	Radio	.06	
	Across river (North) from F-5	Radio	.09	

DATE	LOCATION AND VEGETATION TYPE	SIGHTING TYPE	NUMBER & CLASSIFICATION	COMMENTS
11/17	½ mile downstream from mouth of Cowboy canyon on South Side of river Riparian	Radio	.05	
	¼ mile below Evac. pipeline Riparian	Radio	.06	
	¼ mile West of X-2 on North side of river. Riparian	Radio	.02	
11/19	Under Evac. pipeline Riparian	Radio	.06	
	On North side of river F-5 Riparian	Radio	.09	
11/25	¼ mile above Evac. pipeline on North side of river Riparian	Radio	.06	
	1 ½ mile due North of S-4 on North side of river Riparian	Radio	.02	

DATE	LOCATION AND VEGETATION TYPE	SIGHTING TYPE	NUMBER & CLASSIFICATION	COMMENTS
11/25	½ mile down-stream from mouth of Cowboy Canyon on North side of river.	Radio	.05	
	Riparian			

C. TERRESTRIAL INVERTEBRATES - IDENTIFICATION LIST OF INSECTS

INSECTS OF OIL SHALE TRACTS, BONANZA, UTAH

Diptera

TEPHRITIDAE
- *Neaspilota* sp #1
- *Tephritis avaneosa* Coq.
- *Aciurina ferruginea* Doane
- *Paraterellia* sp #1
- *Euaresta aequalis* Lw.
- *Euaresta tapetis* Coq.
- *Paroxyna clathrata* Lw.
- *Paroxyna* sp. #1
- *Paroxyna* sp. #2
- *Paracantha cultaris* Coq.
- *Procecidochares minuta* (Snow)
- *Procecidochares* sp #1
- *Tripanea bisetosa* Coq.
- *Trupanea wheeleri* Curr.
- *Trupanea nigricoris* Coq.
- *Trupanea* sp #1
- *Oxyna utahensis* Quisen
- *Oxyna aterimma* Doane
- *Eutreta diana* (O.S.)
- Genus #1 sp #1

OTTI

OTTITIDAE
- *Melieria canus* Loew.
- *Physiophora demandata* (F.)
- *Ceroxys latiuscula* (Loew)
- *Otites pyrrhocephala* (Loew)
- *Otites* sp #1
- *Oedopa capito* Loew
- *Paroedopa punctigera* Coq.?
- *Tritoxa pollinosa* Cole
- *Tritoxa* sp #1
- *Euxesta nitidiventris* (Loew)
- *Euxesta* sp. #1
- Genus #1 sp #1
- Genus #1 sp #2

SEPSIDAE
- *Sepsis neocynipsea* M & S
- *Sepsis biflexuosa* M & S

ANTHOMYZIDAE
- *Anthomyza* sp #1

DROSOPHILIDAE
- *Scaptomyza* sp #1
- *Scaptomyza* sp #2
- *Drosophila* sp #1

LONCHAEIDAE
- *Lonchaea* sp #1
- *Dasiops* sp #1
- " sp #2
- " sp #3

AGROMYZIDAE
- *Agromyza* sp #1
- " " sp #2
- " " sp #3
- *Melanagromyza* sp #1
- *Melanagromyza* sp #2
- *Ophomyia* sp #1
- " " sp #2
- " " sp #3
- " " sp #4
- *Phytagromyza* sp #1
- " " sp #2
- " " sp #3
- " " sp #4
- " " sp #5
- " " sp #6
- *Ceradonta* sp #1
- *Ceradonta* sp #2
- *Haplomyza* sp #1
- *Liriomyza* sp #1
- " " sp #2
- " " sp #3
- " " sp #4
- " " sp #5
- " " sp #6
- " " sp #7
- " " sp #8
- *Phytobia* sp #1
- " " sp #2
- " " sp #3
- " " sp #4
- " " sp #5
- *Phytoliriomyza* sp #1

MICROPEZIDAE
- *Micropeza* sp #1

ASTEIDAE
- *Asteia multipunctata* Sabr.

Chamaemyiidae
- *Chamaemyia* sp #1
- *Leucopis* sp #1
- " " sp #2
- " " sp #3

SCIOMYZIDAE
Pherbellia nana (Fall.)

TRIXOSCELIDAE
Trixoscela sp #1
" " sp #2
" " sp #3
" " sp #4
" " sp #5
" " sp #6
Spilochroa sp #1

TETHINIDAE
Pelomyia coronata Lw.
Tethina sp #1
Pelomyiella mallochi (Sturt.)
Pelomyiella melanderi (Sturt.)

LAUXANIIDAE
Camptoprosopella borealis Shew.
Minettia sp #1

HILARIMORPHIDAE
Hilarimorpha sp #1

SPHAEROCERIDAE
Leptocera sp #1
" " sp #2
" " sp #3

EPHYDRIDAE
Atissa sp #1
Allotrichoma sp #1
Allotrichoma sp #2
Ditrichophora sp #1
Discocerina sp #1
Discocerina sp #2
Ephydra nacellaria Egg.
" sp #1
" sp #2
Hydrellia sp #1
" " sp #2
" " sp #3
Mosillus tibialis Cress.
Ochthera mantis D.G.
Notiphilus sp #1
Pelina truncata Loew
Pelina sp #1
Illythea sp #1
Philygrid debilis Loew.
Paracoenia bisetosa Coq.

EPHYDRIDAE (continued)
Paracoenia twibida Curr.
Paracoenia sp #1
Parydra parasocia Claus.
Psilota compta (Meig)
Psilota olga Cress.
Lamproscatella sp #1
Scatella sp #1
Scatella sp #2
Genus #1 sp #1

CHLOROPIDAE
Chlorops lituratus Adams
Chlorops sp #1
Aphanotrigonum sp #1
Diplotoxa sp #1
" " sp #2
" " sp #3
" " sp #4
Diplotoxa recurra Adams
Lasiosina approximatonervis Loew
Lasiosina sp #1
Meromyza pratorum Meig
Thaumatomyia appropinqua Adams
Thaumatomyia sp #1
" " sp #2
" " sp #3
" " sp #4
" " sp #5
Cetema sp #1
Hapleginella conicola Greene
Gaurax sp #1
Elachiptera sp #1
Oscinella sp #1
" " sp #2
" " sp #3
" " sp #4
" " sp #5
" " sp #6 and sp #7
Olcella sp #1
" " sp #2
" " sp #3
" " sp #4
Hippelates pusio Loew
Hippelates sp #1
Siphonella neglecta Becker
" " sp #1
" " sp #2
" " sp #3
Eribolus nanus Becker
Lasiopleura sp #1
Genus #1 sp #1
Genus #2 sp #1
Genus #2 sp #2

MILICHIIDAE
Milichiella sp #1
Milichiella sp #2
Hemeromyia washingtona Meig.?
Hereromyia sp #1
Meoneura sp #1
Meoneura sp #2
Madiza glabra
Pholeomyia sp #1
Eusiphona sp #1
Leptometopa halteralis
Leptometopa latipes Meig.
Leptometopa sp #1
Desmometopa sp #1

SYRPHIDAE
Asemosyrphus polygrammus Lw.
Allograpta obliqua Say
Ceriana tridens Lw.
Baccha lemur O.S.
Eumerus strigatus Fall.
Eristalis tenax (L.)
Eristalis stipitator O.S.
Eupeodes volucris O.S.
Helophilus latifrons Lw.
Chrysotoxum integre Will.
Chrysotoxum ventricosum Lw.
Melanostoma sp #1
Melanostoma sp #2
Paragus bicolor F.
Paragus tibialis Fall.
Platycheirus sp. #1
Neocnemodon sp #1
Mesogramma marginata Say
Scaeva pyrastri L.
Syrphus sp #1
Metasyrphus sp #1
Tropidea quadrata Say
Sphaerophoria sp #1
Xylota flavitibia Bigot
Xylota sp #1
Volucella satura O.S.
Volucella candata Cum.
Syritta pipiens (L.)

CONOPIDAE
Physocephala texana Will.
Zodion fulbifrons Say
Zodion cinereiventre V.D.
Zodion americanum Weid.
Thecophora propinqua Adams
Thecophora nigripes Cam.
Robertsonmyia parva V.D.

STRATIOMYIDAE
Sargus cuprarius (L.)
Nemotelus canadensis Lw.
Nemotelus communus Hanson
Nemotelus sp #1

TABANIDAE
Silvius quadrivitattus Say
Tabanus punctifer L.

THEREVIDAE
Thereva johnsoni Coq.
Thereva fucata Loew.
Thereva sp #1

PHORIDAE
Megaselia sp #1
" " sp #2
" " sp #3
" " sp #4
" " sp #5
Phora velutina (Meig.)

EMPIDAE
Hemerodromia sp #1
Platypalpus sp #1
Platypalpus sp #2
Hilara sp #1
Neoplasta sp #1
Drapetis sp #1
Empis sp #1
" sp #2
" sp #3

BOMBYLIIDAE
Villa sp #1
" " sp #2
" " sp #3
" " sp #4
" " sp #5
" " sp #6
" " sp #7
Villa lepidota (O.S.)
Villa Syrtis Coq.
Villa lateralis Say
Villa capra Coq.
Villa morio (L.)
Villa sinuosa Weid.
Anthrax irroratus Say
Anthrax piesia Curran
Anthrax limatulus artemisia Marst.
Dipalta serpentina O.S.

Epacmus sp #1
Systoechus vulgaris Lw.
Toxophora virgata O.S.
Geron sp #1
" sp #2
" sp #3
" sp #4
" sp #5
Phthiria sulphurea Lw.
Phthiria sp #1
" " sp #2
" " sp #3
" " sp #4
" " sp #5
" " sp #6
" " sp #7
" " sp #8
Oligodranes sp #1
" " " sp #2
" " " sp #3
Peocilanthrax signatipennis (Cole)
Poecilanthrax willistoni (Coq.)
Exoprosopa caliptera Say
Neacreotrichus sp #1
Mythicomyia sp #1
" " sp #2
" " sp #3
" " sp #4
" " sp #5
" " sp #6
" " sp #7
" " sp #8
" " sp #9
" " sp #10
" " sp #11
" " sp #12
" " sp #13
" " sp #14
" " sp #15
" " sp #16
" " sp #17
Mythicomyia atra Cress.
Prorates sp #1

ASILIDAE
Proctocantha nearno Tns.
Efferia sp #1
" " sp #2
" " sp #3
Promachus aldrichii Hine

ASILIDAE (continued)
Philonicus sp #1
Mallophorina guildiana Will.
Stichopogon trifasciatus Say
Asilus cumbipilosa Addison
Asilus mesae Tucker
Asilus compositus Hine
Holopogon atrifrons Cole
Holopogon albipilosus Curran
Holopogon sp #1
Holopogon sp #2
Asilus tuxpanganus Ball
Asilus vescus Hine
Wilcoxia cineria James
Leptogaster sp #1
" " " sp #2
" " " sp #3
" " " sp #4

D. AQUATIC BIOLOGY
1. QUALITATIVE ALGAE - PERIPHYTON

E-1 periphyton - algae

Collected IX-30-75

Field note: Vaucheria & Spirogyra growing in mats along left bank 100' downstream of Hells Hole Canyon. These genera abundant only at this station. Diatoms growing in clumps on barely submerged rock shelf; yellow-green to dark brown - slimy feel. Clumps to 5 cm. long.

Diatoma vulgare	- abundant
Clothrix sp	common
Chaetophora (?) sp	rare
Gomphonema	Abund
Synedra spp	common
Surirella	Rare
Mougeotia	infrequent
Spirogyra	common
Vaucheria	abundant

F-2 Algae - periphyton

Collected IX-26-75

Field note: Algal community on shallowly submerged stones less conspicuous than anticipated ~~not~~ green color not apparent from river bank.

Lab note:

Cladophora sp	Dominant (#1)	
Cocconeis placentula	#2	± equal
Diatoma vulgare	#3	± equal
Stomphonema olivaceum	#4	± equal
Navicula spp	#5	
Nitzschia spp	#6	
Synedra spp	7	
Fragillaria capucina	8	
Surirella sp	9	
Gyrosigma sp	10	
Epithemia sorex	11	

(F-2 cont)

Cylindrotheca gracilis	12
Rhopalodia sp	13
Amphiprora paludosa	14
Oscillatoria sp	15

Cladophora clearly most abundant, followed by + equal numbers of *Cocconeis*, *Diatoma* and *Gomphonema* *Navicula* & *Nitzschia* common, others infrequent to rare.

F-3 Periphyton Collected IX-25-75

Scraped from periphyton float and metal frame of turbidimeter. Little to no algae on periphyton strips - abundant growth on the float itself.

Cladophora sp.	abundant (#1 sp)
Diatoma vulgare	#2 (order abundance)
Navicula spp	#3
Cymbella sp	#4
Fragillaria sp.	#5
Diatoma hiemale	#6
Gomphonema	7 (uncommon)
Rhoicosphenia	8 Rare
Anabena	Rare

Note absence of Cocconeis sp.

F-5 Algae - Periphyton Collected IX-30-75

Field note: Collected from periphyton boat anchored at station A-11. Boat was waterlogged; only 1 periphyton strip remained. It was covered with silt.

Genera	Order of abundance
Cladophora (glomerata?)	#1 Abund
Epithemia sorex	#2 "
Cocconeis placentula	3 "
Navicula spp	4 "
Gomphonema diacerum	5 "
Synedra sp	6 common
Diatoma vulgare	7 "
Cylindrotheca (gracilis?)	8 "
Rhopalodia sp.	9 "
Pinnularia sp	10 "
Tabellaria sp	11 "
Microspora sp	12 Infreq.

1F-5 IX-30-95 (cont.)

Amphiprora pellucida	13	Rare
Protozoa (Ciliata)	14	Rare
Ceratium	15	Rare

D. AQUATIC BIOLOGY
2. EKMAN DREDGE SAMPLE DATA

Ekman Dredge Samples

F-1 Collected X-01-75

Ekman # 1	Total capture
Ophiogomphus severus	1
Ekman 2	0
Ekman 3	
Ophiogomphus severus	1
Ekman 4	6
Ekman 5	0

Taken from sandy silt substrate 50± meters upstream from gage.

F-2 Ekman Samples Collected IX-26-7

Ekman Sample		total
#1	Ceratopogonidae	1
#2		0
#3		0
#4	Ophiogomphus severus	4
	Limnodrilus claparedianus	5
	Ceratopogonidae	1
	total	10
#5	Ophiogomphus severus	1
	Ceratogonidae	1
	Limnodrilus (?) sp	1
	~~#10~~ Chironomus undulata	1
	Chironomidae (Stictochironomus)	1
	total	5

15 / 5 samples

average 3 / 36 in^2 - 12 / ft^2

E-3 Ekman Samples

Collected IX-25-15

Sample #		total
1		0
2		0
3	Ophiogomphus severus	2
4		0

Average 2 organisms/ft^2

F-4 Ekman Sample Collected IX-24-75

Sample		Total
1	Ceratopogonidae 1 Simuliidae 1	2
2		0
3	Chironomidae 1 Tanytarsus dispariedianus B	4

F5 Ekman Collected IX-30-75

Ekman		Total
1		0
2		0
3	Oplodontus severus	1
4		0
5	Chironomidae	1

D. AQUATIC BIOLOGY

3. QUALITATIVE PLANKTON DATA - SEDGEWICK RAFTER COUNTS

F-1 & 2 collected X-01-75 69 mL Concentrate

Cell 1

Strips	Count	Genera
1	101	Cyclotella
2	96	
		Navicula
3	110	
4	102	Epithemia sorex
	409	

409 / mL conc
69 / mL H2O

(#1) Coscinodiscus

Cell 2

1	74	Chaetoceros
2	111	
3	107	Diatoma
4	100	
	392	Asterella (rare)

1960 / mL conc

61 / mL H2O
Cell Set 5

1	93	Cladophora
		Synedra
2	116	
3	101	
4	104	
	414	

2070 / mL conc
63 / mL H2O

afk

X 63 / mL H2O
63,000 / L

F-2 & 2

89 ml concentrate
collected IX-26-75

cell 1

strip	count
1	80
2	79
3	102
4	127
	388

78/ml H_2O

cell 2

strip	count
1	114
2	115
3	110
4	99
	438

3190/ml concentrate
89/ml H_2O

cell 3

strip	count
1	129
2	102
3	107
4	132
	470

7350/ml concentrate
95 cells/ml H_2O

Genera

Gomphonema

Diatoma

Nitzschia
(several spp.)

Fragillaria

Cymbella

* Closterium
(only 1 seen)

Cladophora

AJR

E-3 Quantitative (21) 74 ml. concentrate
Collected X-25-75

Cell 1

Strip	Count
1	167
2	184
3	214
4	155
	720

3600 cells/ml Concentrate
121 cells/ml H2O

Navicula
coconeis
Navicula
cryptella
Cocconeis
placentula
var. euglypta
Synedra
Diatoma
Nitzschia
Epithemia
E. capucina

Cell 2

1	159
2	149
3	137
4	166
	611

Rhopalodia

3055 / ml conc.
103 / ml H2O
03,000 / L.

E-3 & 4 cont (IX-25-75)

Cells

strip	count
1	177
2	151
3	136
4	184
	648

3240 cells/ml conc

109 cells/ml H2O

(108,981 cells/plate)

C/R

Culture # 2-4-13

E-4 & 3

60 Ml

cell 1

strip	count
1	89
2	76
3	111
4	71
	347

347 / 5 = 69.4

69.4 x 0.68 = 47.192

47.32 cells/ml

~~cell 2~~

cell 2

strip	count
1	80
2	81
3	116
4	68
	345

345 / 5 = 69

69 x 0.68 = 46.92

47.0

cell 3

1	109
2	121
3	102
4	112
	439

439 / 5 = 87.8

87.8 x 0.68 = 59.704

59.9 cells/ml

F-5 & 1 — 86 ml Concentrate collected Tuesday at IX-30-75

Cell #1

Strip	Opuntella	Count
1	Pleurosigma	93
2	Cylindrotheca (acicc)	82
3		104
4		106
		385

1925 /ml Conc
68 /ml H2O

1	62
2	93
3	93
4	85
	333

1665 /ml Conc
67 /ml H2O

F5
d1

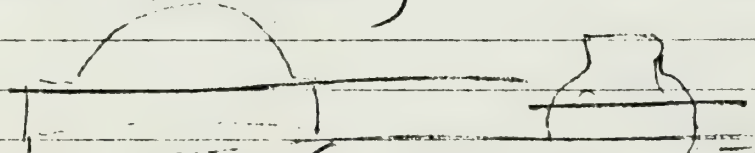
cell 3

strip	count	Asterionella Rhoicosphenia
1	124	
2	101	Meridion Synedra
3	99	
4	88	
	412	

2060/ml conc
93/ml H_2O

C/R

F-5 Algae
Epithemia abundant
Amphipleura
Navicula
Cocconeis
Cymbella (rare)
Surirella
Rhopalodia (rare)



Epithemia rest common to Round
Synedra
Nitzschia sigmoidea

F-6 K sample 1 — 100 ml concentrate
Collected IX-26-75

Cell #1

Strips	Count	Genera
1	135	#1 Cylindrotheca
2	112	Navicula
3	234	Diatoma
4	146	Fragillaria
	627	Amphora
		Opephora
		Vanheurkia (rare)

3135 cells/ml concentrate
143 cells/ml H_2O

Cell ~~Strip~~ 2

	count	
1	199	Rhopalodia
2	127	
3	214	
4	155	
	695	

3475 cells/ml concentrate
158 cells/ml H_2O

F-4 & 1
Cell 3

Strip	count
1	108
2	116
3	149
4	189
	562

2810 cells/mul concentrate

128 cells/mul H_2O

143
158
128
429 / 3 = 143 cells/mul average

CFR

D. AQUATIC BIOLOGY

4. INVERTEBRATE DATA - SURBER SAMPLES

MACROINVERTEBRATE LAB WORKSHEET

Surber

Project NO. GLI-1

Station No. F-1 Sample No. 1 Sampling Method Rival (Surber) Collection Date X-01-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagena*	*elegantula* ✓		1
		Rhithrogena	*undulata* ✓		6
	Baetidae	*Baetis* spp	~~*bicaudatus*~~ ✓		15
		Pseudocloeon			
		Callibaetis			
		Ephemerella	✓		
		Trichorythodes	~~*minutus*~~ ✓		36
		Lachlania	✓		
		Traverella	*albertana* ✓		27
Odonata	Gomphidae	*Gomphus*	*intricatus*		43
		Ophiogomphus	*severus* ✓		45
	Libellulidae				
	Aeschnidae				
Plecoptera	Perlodidae	*Isogenus* ✓	✓		
		Arcynopteryx			
	Perlidae	*Taenionema*	*pacifica*		65
		Acroneuria			
Trichoptera	Hydropsychidae	*Hydropsyche*	✓		
	Limnephilidae				
	Brachycentridae	*Brachycentrus*			
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*		81
	Gerridae	Trepobates	✓		
		Metrogerris	✓		
Coleoptera	Dytiscidae	*Agabus*			
	Elmidae				
Diptera	Simuliidae		✓		
	Culicidae				
	Chironomidae		✓		
	Ceratopogonidae	Forcipomyia	✓		
				TOTAL	

Biologist [signature] Total Number of Taxa 16

F-1 is more productive than this indicates --several small stones from deeper H_2O up to 20 Traverella

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 1517

Station No. F-1 Sample No. 1 Sampling Method SURBER Collection Date X-01-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagena*	*elegantula* 17+1	~~18~~ 19	1
		~~Epeorus (Ecdyonurus)~~		~~1~~	
		Rhithrogena	*undulata* 9	9	6
	Baetidae	*Baetis*	*bicaudatus* 24	24	15
		SP	3	3	
		Callibaetis			
		Dactylobaetis	~~2~~ 6	6	
		Ephemerella	3+14+32=	17	
		Trichorythodes	~~minutus~~ edmundsi	1	36
		Lachlania			
		Traverella	*albertana* 9	9	21
Odonata	Gomphidae	*Gomphus*	*intricatus*		43
		Ophiogomphus	*severus*		45
	Libellulidae				
	Aeschnidae				
Plecoptera	Perlodidae	*Isogenus*			
		Arcynopteryx			
		Isogenoides	Olivaceus	2	
	Perlidae	*Taeniopteryx*	*pacifica*		65
		Acroneuria			
Trichoptera	Hydropsychidae	*Hydropsyche*	4	4	
	Limnephilidae				
	Brachycentridae	*Brachycentrus*			
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*		81
	Gerridae				
Coleoptera	Dytiscidae	*Agabus*			
	Elmidae				
Diptera	Simuliidae		pupa	1	
	Culicidae				
	Chironomidae			2	
	Ceratopogonidae				
			TOTAL	97	

Biologist [signature] Total Number of Taxa 12

$\bar{d} = 3.0$

Most Traverella near emergence
Chemerella all early instar
Pseudocleon mixed

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 1517-1

Station No. F-1 Sample No. 2 Sampling Method Surb Collection Date X-01-75

(instars: 1

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagena*	*elegantula*	~~52~~	1
		Rhithrogena	*undulata* mostly very early	~~8+2~~	6
		Baetidae *Baetis*	*bicaudatus*	3	15
		~~Callibaetis~~	sp. A	~~2~~	
			sp. B	~~9~~	
		Ephemerella	*inermis* (?)	~~+3~~ 11	
		Trichorythodes	*minutus*		36
		Lachlania *Traverella*	*albertana* mid to last instar	~~32++~~	27
Odonata	Gomphidae	*Gomphus*	*intricatus*		43
		Ophiogomphus	*severus*	1	45
	Libellulidae				
	Aeschnidae				
Plecoptera	Perlodidae	*Isogenus* *Arcynopteryx*			
	Perlidae	*Taenionema*	*pacifica*		65
		Acroneuria			
Trichoptera	Hydropsychidae	*Hydropsyche*		5	
	Limnephilidae				
	Brachycentridae	*Brachycentrus*			
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*		81
	Gerridae				
Coleoptera	Dytiscidae	*Agabus*			
	Elmidae				
Diptera	Simuliidae				
	Culicidae				
	Chironomidae			1	
	Ceratopogonidae				
			TOTAL	125	

Biologist [illegible] Total Number of Taxa 10

Traverella most common (est). $\bar{d} = 2.55$

Ophiogomphus + Acroneuria

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 1617

Station No. E1 Sample No. 3 Sampling Method Surber Collection Date X-01-95

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagena*	*elegantula* 17-19	19	1
		Rhithrogena	*undulata* 3	3	6
	Baetidae	~~*Baetis*~~	~~*bicaudatus* 1~~		15
		Pseudocloeon	1	1	
		Callibaetis			
		Ephemerella			
		Trichorythodes	*minutus*		36
		Lachlania			
		Traverella	*albertana* 10	10	27
Odonata	Gomphidae	*Gomphus*	*intricatus*		43
		Ophiogomphus	*severus*		45
	Libellulidae				
	Aeschnidae				
Plecoptera	Perlodidae	*Isogenus*			
		Arcynopteryx			
	Perlidae	*Taenionema*	*pacifica*		65
		Acroneuria			
Trichoptera	Hydropsychidae	*Hydropsyche*	4	4	
	Limnephilidae				
	Brachycentridae	*Brachycentrus*			
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*		81
	Gerridae				
Coleoptera	Dytiscidae	*Agabus*			
	Elmidae				
Diptera	Simuliidae				
	Culicidae				
	Chironomidae			12	
	Ceratopogonidae				
			TOTAL	39	

Biologist CKay Total Number of Taxa 6

$\bar{J} = 1.99$

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 1517-1

Station No. E-1 Sample No. 4 Sampling Method SURBER Collection Date X-01-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagenia*	*elegantula* 37+111	44	1
		Rhithrogena	*undulata*	18	
	Baetidae	*Baetis*	(trilail)	2	6
		Pseudocloeon	*turbidum*	7	15
		Dactylobaetis	*cepheus*	3	
	Ephemerellidae	*Ephemerella*		9	
	Trichorythidae	*Trichorythodes*	*minutus*	2	
	Oligoneuriidae	*Lachlania*	*saskatchewanensis*	14	36
	Leptophlebiidae	*Traverella*	*albertana* 75+42+11	128	27
					43
		Ophiogomphus	*severus*	2	45
	Libellulidae				
	Aeschnidae				
Plecoptera	Perlodidae	*Isogenoides*		2	
		Arcynopteryx			
	Perlidae	*Taenionema*	*pacifica*		65
		Acroneuria			
Trichoptera	Hydropsychidae	*Hydropsyche*		3	
	Limnephilidae				
	Brachycentridae	*Brachycentrus*			
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*	1	81
	Gerridae				
Coleoptera	Dytiscidae	*Agabus*			
	Elmidae				
Diptera	Simuliidae	pupa 3	larva 3	6	
	Culicidae			4	
	Chironomidae			9	
	Ceratopogonidae				
			TOTAL	225	

Biologist [signature] Total Number of Taxa 14

d = 2.31

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 1517-17

Station No. F-1 Sample No. 5 Sampling Method Surber Collection Date X-01-85

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagenia*	*elegantula*	21	1
		Rhithrogena	*undulata*	12	
	Baetidae	*Baetis*	SpA (Traviaud)	4	6
		Pseudocloeon	*turbidum*	9	15
		Dactylobaetis	*cepheus*	4	
	Ephemerellidae	*Ephemerella*	*inermis* & *minerva*	21	
	Trichorythidae	*Trichorythodes*	*minutus*	1	
	Oligoneuriidae	*Lachlania*	*saskatchewanensis*	1	36
	Leptophlebiidae	*Traverella*	*albertana*	136	27
				100+20+16	43
		Ophiogomphus	*severus*	4	45
	Libellulidae				
	Aeschnidae				
Plecoptera	Perlodidae	*Isogenoides*		12	
		Arcynopteryx			
	Perlidae	*Taeniopteryx*	*pacifica*		65
		Acroneuria			
Trichoptera	Hydropsychidae	*Hydropsyche*		19	
	Limnephilidae				
	Brachycentridae	*Brachycentrus*			
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*	~~1~~	81
	Gerridae Veliidae	*Rhagovelia*	*distincta*	2+	
Coleoptera	Dytiscidae	*Agabus*			
	Elmidae				
Diptera	Simuliidae			2	
	Culicidae				
	Chironomidae			9	
	Ceratopogonidae				
			TOTAL	281	

~~Rhagovelia~~ Rhagovelia accidental washing.

Biologist Clay Total Number of Taxa ~~16~~ 15

Dead on capture? ± 20, in good condition

D = 1.5

+ others

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 1517

Station No. F-2 Sample No. _____ Sampling Method Qual Collection Date IX-26-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagena*	*elegantula*	✓	1
		Rhithrogena	*undulata*		6
	Baetidae	*Baetis*	*bicaudatus*		15
		Callibaetis			
		Ephemerella		✓	
		Trichorythodes	*minutus*		36
		Lachlania			
		Traverella	*albertana*	✓	27
		Choroterpes	albiannulata		
Odonata	Gomphidae	*Gomphus*	*intricatus*		43
		Ophiogomphus	*severus*		45
	Libellulidae				
	Aeschnidae				
Plecoptera	Perlodidae	*Isogenus*			
		Arcynopteryx			
	Perlidae	*Taenionema*	*pacifica*		65
		Acroneuria			
Trichoptera	Hydropsychidae	*Hydropsyche*		✓	
	Limnephilidae				
	Brachycentridae	*Brachycentrus*			
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*		81
	Gerridae				
Coleoptera	Dytiscidae	*Agabus*			
	Elmidae				
Diptera	Simuliidae				
	Culicidae				
	Chironomidae				
	Ceratopogonidae				
				TOTAL	

Biologist _____ Total Number of Taxa 3

+ traverella mostly late to last instar

MACROINVERTEBRATE LAB WORKSHEET

Project NO. _____

Station No. F-2 Sample No. 1 Sampling Method Qual Collection Date IX-26-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagena*	*elegantula* ✓		1
		Rhithrogena	*undulata* ✓		6
	Baetidae	*Baetis*	~~*bicaudatus*~~ ✓		15
		DACTYLOBAETIS	CAPUTUS ✓		
		Callibaetis			
		PSEUDOCLOEON	✓		
		Ephemerella			
		Trichorythodes	*minutus*		36
		Lachlania			
		Traverella	*albertana* ✓		27
Odonata	Gomphidae	*Gomphus*	*intricatus*		43
		Ophiogomphus	*severus*		45
	Libellulidae				
	Aeschnidae				
Plecoptera	Perlodidae	*Isogenus*			
		Arcynopteryx			
	Perlidae	*Taenionema*	*pacifica*		65
		Acroneuria			
Trichoptera	Hydropsychidae	*Hydropsyche*	✓		
	Limnephilidae				
	Brachycentridae	*Brachycentrus*			
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*		81
	Gerridae				
Coleoptera	Dytiscidae	*Agabus*			
	Elmidae				
Diptera	Simuliidae	✓			
	Culicidae				
	Chironomidae	✓			
	Ceratopogonidae				
			TOTAL		

Biologist _____ Total Number of Taxa _____

MACROINVERTEBRATE LAB WORKSHEET

Project NO. _____

Station No. F-2 Sample No. 1 Sampling Method Surber Collection Date IX-26-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagena*	*elegantula* 42	42	1
		Rhithrogena	*undulata* 24	24	6
	Baetidae	*Baetis*	*bicaudatus* 69+1	70	15
		Dactylobaetis	2	2	
		Callibaetis			
		Ephemerella	3+4	7	
		Trichorythodes	*minutus* ad *mundus*	4	36
Caddisfly ←		*Lachlania*	1	1	
		Traverella	*albertana* 4+1	5	27
		Drunella spp	1	1	
Odonata	Gomphidae	*Gomphus*	*intricatus*		43
		Ophiogomphus	*severus* 2	2	45
	Libellulidae				
	Aeschnidae				
Plecoptera	Perlodidae	*Isogenus*			
		Arcynopteryx			
	Perlidae	*Taenionema*	*pacifica*		65
		Acroneuria			
Trichoptera	Hydropsychidae	*Hydropsyche*	66	66	
	Limnephilidae				
	Brachycentridae	*Brachycentrus*			
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*		91
	Gerridae				
Coleoptera	Dytiscidae	*Agabus*			
	Elmidae				
Diptera	Simuliidae				
	Culicidae				
	Chironomidae		2	2	
	Ceratopogonidae				
		Tanytarsus	2	2	
			TOTAL	228	

Biologist _____ Total Number of Taxa 13

$\bar{d} = 2.52$

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 1517-17

Station No. E-2 Sample No. 2 Sampling Method SURBER Collection Date IX-26-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagena*	*elegantula*	6	1
		Rhithrogena	*undulata*	34	6
		BAETIS	SP A	2	
	Baetidae	*Baetis*	*bicaudatus*	36	15
		PACTYLOBAETIS	R	2	
		Callibaetis			
		Ephemerella	SP	7	
		Trichorythodes	*minutus*		35
		Lachlania			
		Traverella	*albertana*	18	27
Odonata	Gomphidae	*Gomphus*	*intricatus*		43
		Ophiogomphus	*severus*		45
	Libellulidae				
	Aeschnidae				
Plecoptera	Perlodidae	*Isogenoides*		3	
		Arcynopteryx			
	Perlidae	*Taenionema*	*pacifica*		65
		Acroneuria			
Trichoptera	Hydropsychidae	*Hydropsyche*		5	
	Limnephilidae				
	Brachycentridae	*Brachycentrus*			
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*		81
	Gerridae				
Coleoptera	Dytiscidae	*Agabus*			
	Elmidae				
Diptera	Simuliidae	many pupoaria		3	
	Culicidae				
	Chironomidae		SP A	2	
			type	1	
	Ceratopogonidae				
		Limnophila		1	
		Naudeum		1	
			TOTAL	118	

Biologist [signature] Total Number of Taxa 14

$\bar{d} = 2.62$

20 very few Traverella
Gomphids nearly equal -- all others in between

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 15177

Station No. F-2 Sample No. 3 Sampling Method Surber Collection Date IX-26-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagena*	*elegantula* ~~28~~ 39	39	1
				8	
		Rhithrogena	*undulata* ~~4~~ 8		6
	Baetidae	*Baetis*	*bicaudatus* ~~20~~ 21	21	15
		Baetis tricaudatus	~~2~~ 3	3	
		Callibaetis, Pacylobaetis	~~2~~ 4	4	
		Ephemerella	7	7	
		Trichorythodes	*minutus* 5 *schmitzi*	5	36
		Lachlania			
		Traverella	*albertana* "	11	27
Odonata	Gomphidae	*Gomphus*	*intricatus*		43
		Ophiogomphus	*severus* / *mesaeneregensis*	~~3~~ 2	45
	Libellulidae				
	Aeschnidae				
Plecoptera	Perlodidae	*Isogenus*			
		Arcynopteryx			
	Perlidae	*Taenionema*	*pacifica*		65
		Acroneuria			
Trichoptera	Hydropsychidae	*Hydropsyche*	9	9	
	Limnephilidae				
	Brachycentridae	*Brachycentrus*			
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*		81
	Gerridae				
Coleoptera	Dytiscidae	*Agabus*			
	Elmidae				
Diptera	Simuliidae		pupae	3	
	Culicidae				
	Chironomidae	orthocladius (?)		2	
	Ceratopogonidae				
		Tanypodinae		1	
			TOTAL	115	

Biologist [signature] Total Number of Taxa 12

$\bar{d} = 3.02$

$\bar{d} = 3.03$

Rhithrogena I = biomass
E. prepnerella, Baetis
Hydropsyche & Pseudocloeon early to late

Chloroperles nearly mature (ready to emerge)

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 1511

Station No. E2 Sample No. 4 Sampling Method Surber Collection Date IX-26-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagenia*	*elegantula*	23	1
		Rhithrogena	*undulata*	12	
	Baetidae	*Baetis*	Sp. A	4	6
		Pseudocloeon	*turbidum*	20	15
		Dactylobactis	*cepheus*		
	Ephemerellidae	*Ephemerella*	*inermis* (?)	3	
	Trichorythidae	*Trichorythodes*	*minutus*	2	
	Oligoneuriidae	*Lachlania*	*saskatchewanensis*		36
	Leptophlebiidae	*Traverella*	*albertana*	29	27
		Chloroperles	*adnexus*	4	
					43
		Ophiogomphus	*severus*		45
	Libellulidae				
	Aeschnidae				
Plecoptera	Perlodidae	*Isogenoides*	*Esmeralda*	1	
		Arcynopteryx			
	Perlidae	*Taeniopteryx*	*pacifica*		65
		Acroneuria			
Trichoptera	Hydropsychidae	*Hydropsyche*	13+1	24	
	Limnephilidae				
	Brachycentridae	*Brachycentrus*			
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*		81
	Gerridae				
Coleoptera	Dytiscidae	*Agabus*			
	Elmidae				
Diptera	Simuliidae	5 larvae 2 pupae		7	
	Culicidae				
	Chironomidae *			5	
	Ceratopogonidae				
	Ephydridae			1	
		Limnodrilus	*claparedianus*	2	
		Enchytraeus (asbrorni?)		1	
			TOTAL	263	

Biologist _____ Total Number of Taxa 15

* larvae only - Orthocladius (?) $\bar{d} = 2.78$

2 spp Baetis - 4c Simulio - 3c 2 (similar to Pseudocleon but different color pattern

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 1517

ation No. E-2 Sample No. 5 Sampling Method Surber Collection Date IX-26-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagenia*	*elegantula*	68	1
		Rhithrogena	*undulata*	4	
	Baetidae	*Baetis*	sp. A	4	6
			Sp. B	5	
		Pseudocloeon	*turbidum*	19	15
		Dactylobaetis	*cepheus* (removed)	4	
	Ephemerellidae	*Ephemerella*		17	
	Trichorythidae	*Trichorythodes*	*minutus*	1	
	Oligoneuriidae	*Lachlania*	*saskatchewanensis*		36
	Leptophlebiidae	*Traverella*	*albertana*	68	27
					43
Odonata		*Ophiogomphus*	*severus* 2	2	45
	Libellulidae				
	Aeschnidae				
Plecoptera	Perlodidae	*Isogenus*			
		Arcynopteryx			
	Perlidae	*Taeniopteryx*	*pacifica*		65
		Acroneuria			
Trichoptera	Hydropsychidae	*Hydropsyche*	53 + 1	54	
	Limnephilidae				
	Brachycentridae	*Brachycentrus*			
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*		81
	Gerridae				
Coleoptera	Dytiscidae	*Agabus*			
	Elmidae				
Diptera	Simuliidae				
	Culicidae				
	Chironomidae	*Chironomus*	sp. E (1 pupa) sp 2	4 2	
	Ceratopogonidae				
Empidida				1	
			TOTAL	255	

Biologist _____ Total Number of Taxa 14

$\bar{d} = 2.76$

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 1577

Station No. E-3 Sample No. 1 Sampling Method SURBER Collection Date IX-26-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagenia*	*elegantula* #21	21	1
		Rhithrogena	*undulata* 7	7	
	Baetidae	*Baetis*	~~*tricaudatus* = 11~~	11	6
		Pseudocloeon	*turbidum*	19	15
		Dactylobaetis	*cepheus* 2	2	
	Ephemerellidae	*Ephemerella*			
	Trichorythidae	*Trichorythodes*	*minutus*	4	36
	Oligoneuriidae	*Lachlania*	*saskatchewanensis*		27
	Leptophlebiidae	*Traverella*	*albertana* 28	28	
		CHOROTERPES		1	43
Odonata	Gomphidae	*Ophiogomphus*	*severus*		45
	Libellulidae				
	Aeschnidae				
Plecoptera	Perlodidae	*Isogenoides*	*Frontalis*	2	
		Arcynopteryx			
	Perlidae	*Taenionema*	*pacifica*		65
		Acroneuria			
Trichoptera	Hydropsychidae	*Hydropsyche*	10	10	
	Limnephilidae				
	Brachycentridae	*Brachycentrus*			
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*		81
	Gerridae				
Coleoptera	Dytiscidae	*Agabus*			
	Elmidae				
Diptera	Simuliidae				
	Culicidae				
	Chironomidae		1	1	
	Ceratopogonidae				
			TOTAL	~~96~~ 95	

Biologist [signature] Total Number of Taxa ~~11~~ 10

$\bar{d} = 2.66$

Trichorythodes, Pseudocloeon, Dactylobaetis & Baetis carrying grids

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 517-17

Station No. E-3 Sample No. 2 Sampling Method Surber Collection Date IX-26-75

ORDER	FAMILY	GENUS	SPECIES		NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagena*	*elegantula*	42	42	1
		Rhithrogena	*undulata*	9	9	6
	Baetidae	~~*Baetis*~~ *Pseudocloeon*	~~*bicaudatus*~~		23	15
		Callibaetis				
		Dactylobaetis			4	
		Ephemerella				
		Trichorythodes	*minutus*	4	4	36
		Lachlania				
		Traverella	*albertana*	~~4~~ 5	~~4~~ 5	27
Odonata	Gomphidae	*Gomphus*	*intricatus*			43
		Ophiogomphus	*severus*			45
	Libellulidae					
	Aeschnidae					
Plecoptera	Perlodidae	*Isogenus*				
		Arcynopteryx				
	Perlidae	*Taenionema*	*pacifica*			65
		Acroneuria				
Trichoptera	Hydropsychidae	*Hydropsyche*		4	4	
	Limnephilidae					
	Brachycentridae	*Brachycentrus*				
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*			81
	Gerridae					
Coleoptera	Dytiscidae	*Agabus*				
	Elmidae					
Diptera	Simuliidae					
	Culicidae					
	Chironomidae				2	
	Ceratopogonidae					
			TOTAL		133	

Biologist Clay Total Number of Taxa 8

$\bar{d} = 2.30$ 133/75

Trav 50
2 Trichorythodes minutus (?) & T. Apache removed

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 1517-17

Station No. E-3 Sample No. 3 Sampling Method Surber Collection Date IX-26-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagena*	*elegantula* 18+1111	12	1
		Rhithrogena	*undulata* 15+8+4+111	29	6
	Baetidae	~~*Baetis*~~ *Pseudocloeon* II SP	*bicaudatus* 38 62 .2	38 2	15
		Callibaetis			
		Ephemerella	~~X~~ 6	6	
		TRICHORYTHODES	~~X~~ 1	1	
		Trichorythodes	*minutus*	3	36
		Lachlania			
		Traverella	*albertana* 7/+4+	76	27
	Exuviamonly	*Ephemerid*			
Odonata	Gomphidae	*Gomphus*	*intricatus*		43
	2 near convergence	*Ophiogomphus*	*severus* 3	3	45
	Libellulidae				
	Aeschnidae				
Plecoptera	Perlodidae	*Isogenoides*	*Elongatus (?)* 3 removed	5	
		Arcynopteryx			
	Perlidae	*Taenionema*	*pacifica*		65
		Acroneuria			
Trichoptera	Hydropsychidae	*Hydropsyche*	S(R) REMOVED	56	
	Limnephiliidae				
	Brachycentridae	*Brachycentrus*			
		Lepto cella	1 removed	1	
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*		81
	Gerridae				
Coleoptera	Dytiscidae	*Agabus*			
	Elmidae				
Diptera	Simuliidae	*Ipsoprerum* 5+1		9	
	Culicidae				
	Chironomidae		4	4	
	Ceratopogonidae				
	Ephydridae			1	
	Nardium		Sp	1	
	+	*Limnodrilus*		1	
	Nematoda			1	
			TOTAL	259	

Biologist Clay Total Number of Taxa 18

$\bar{d} = 3.13$

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 1517-1

Station No. E-3 Sample No. 4 Sampling Method Surber Collection Date IX-26-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagena*	*elegantula* 28+1	29	1
		Rhithrogena	*undulata* 1	1	6
	Baetidae	*Baetis*	*bicaudatus* 27	27	15
		Dactylobaetis		1	
		Callibaetis			
		Ephemerella	III	3	
		Trichorythodes	~~minutus~~	2	36
		Lachlania			
		Traverella	*albertana* 29+1	30	27
Odonata	Gomphidae	*Gomphus*	*intricatus*		43
		Ophiogomphus	*severus*		45
	Libellulidae				
	Aeschnidae				
Plecoptera	Perlodidae	*Isogenoides*	1	1	
		Arcynopteryx			
	Perlidae	*Taeniopteryx*	*pacifica*		65
		Acroneuria			
Trichoptera	Hydropsychidae	*Hydropsyche*	14	14	
	Limnephilidae				
	Brachycentridae	*Brachycentrus*			
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*		31
	Gerridae				
Coleoptera	Dytiscidae	*Agabus*			
	Elmidae				
Diptera	Simuliidae				
	Culicidae				
	Chironomidae	*Orthocladius*	*sp* 3	3	
		Chironomus	1	1	
	Ceratopogonidae				
Isopoda	Naididae	*Naidium*	*osborni*	2	
			TOTAL	114	

Biologist C. Ray Total Number of Taxa 11

$\bar{d} = 2.59$

2 parts

MACROINVERTEBRATE LAB WORKSHEET

Project NO 1517

ion No. F-3 Sample No. 5 Sampling Method SURBER Collection Date IX-26-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagena*	*elegantula* 9+7	~~11~~ 17	1
		Rhithrogena	*undulata* ~~3+3+4+4~~	~~46~~	6
	Baetidae	*Baetis*	~~*brunneatus*~~	~~32~~	15
		((	*Sp 1*	1	
		Callibaetis			
		Pseudocloeon		32	
		Ephemerella		3	
		Trichorythodes	~~*minutus*~~ adult	1	36
		Lachlania			
		Traverella	*albertana* ~~2+1+4+9~~	74	27
Odonata	Gomphidae	*Gomphus*	*intricatus*		43
		Ophiogomphus	*severus*		45
	Libellulidae				
	Aeschnidae				
Plecoptera	Perlodidae	*Isogenus* KES		1	
		Arcynopteryx			
	Perlidae	*Taeniopteryx*	*pacifica*		65
		Acroneuria			
Trichoptera	Hydropsychidae	*Hydropsyche*	1+2 3	34	
	Limnephilidae				
	Brachycentridae	*Brachycentrus*			
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*		81
	Gerridae				
Coleoptera	Dytiscidae	*Agabus*			
	Elmidae				
Diptera	Simuliidae	~~2 larvae~~ 3 pupae	3	4	
	Culicidae				
	Chironomidae	CRICOTOPUS	3	3	
	Ceratopogonidae				
			TOTAL	217	

Biologist Clay Total Number of Taxa 12

$\bar{d} = 2.53$

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 1517

ion No. F-4 Sample No. 1 Sampling Method Surber Collection Date IX-24-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagena*	*elegantula*	2	1
		Rhithrogena	*undulata*		6
	Baetidae	*Baetis*	*bicaudatus*		15
		Callibaetis			
		Pseudocloeon			
		Ephemerella		1	
		Trichorythodes	*minutus*	13	36
		Lachlania			
		Traverella	*albertana*	15 16	27
Odonata	Gomphidae	*Gomphus*	*intricatus*		43
		Ophiogomphus	*severus*		45
	Libellulidae				
	Aeschnidae				
Plecoptera	Perlodidae	*Isogenus*			
		Arcynopteryx			
	Perlidae	*Taenionema*	*pacifica*		65
		Acroneuria			
Trichoptera	Hydropsychidae	*Hydropsyche*		1	
	Limnephilidae				
	Brachycentridae	*Brachycentrus*			
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*		81
	Gerridae				
Coleoptera	Dytiscidae	*Agabus*			
	Elmidae				
Diptera	Simuliidae			3	
	Culicidae				
	Chironomidae				
	Ceratopogonidae				
?	2 Tipulidae	*Hexatoma* (?)		2	
			TOTAL	38	

Biologist [signature] Total Number of Taxa 7 $d = 2.07$

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 1517

ion No. F-4 Sample No. 2 Sampling Method Surber Collection Date IX-24-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagena*	*elegantula*	2	1
		Rhithrogena	*undulata*	7	6
	Baetidae	*Baetis*	*bicaudatus*		15
		Callibaetis			
		Ephemerella			
		Trichorythodes	*minutus*		36
		Lachlania			
		Traverella	*albertana*	5	27
Odonata	Gomphidae	*Gomphus*	*intricatus*		43
		Ophiogomphus	*severus*	1	45
	Libellulidae				
	Aeschnidae				
Plecoptera	Perlodidae	*Isogenoides*		1	
		Arcynopteryx			
	Perlidae	*Taenionema*	*pacifica*		65
		Acroneuria			
Trichoptera	Hydropsychidae	*Hydropsyche*			
	Limnephilidae				
	Brachycentridae	*Brachycentrus*			
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*		81
	Gerridae				
Coleoptera	Dytiscidae	*Agabus*			
	Elmidae				
Diptera	Simuliidae				
	Culicidae				
	Chironomidae				
	Ceratopogonidae				
			TOTAL	16	

Biologist C Perry Total Number of Taxa 5

$\bar{d} = 1.92$

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 1517

tion No. E-4 Sample No. 3 Sampling Method SURBER Collection Date IX-24-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagena*	*elegantula*	5	1
		Rhithrogena	*undulata* ✓	10	6
	Baetidae	*Baetis*	~~*bicaudatus*~~	~~1~~	15
		Pseudocloeon	*turbidum*	18	
		Callibaetis			
		Dachtylobaetis	✓	1	
		Ephemerella			
		Trichorythodes	*minutus*		36
		Lachlania	✓		
		Traverella	*albertana* ✓	13	27
Odonata	Gomphidae	*Gomphus*	*intricatus*		43
		Ophiogomphus	*severus*		45
	Libellulidae				
	Aeschnidae				
Plecoptera	Perlodidae	*Isogenus*			
		Arcynopteryx			
	Perlidae	*Taenionema*	*pacifica*		65
		Acroneuria			
Trichoptera	Hydropsychidae	*Hydropsyche*			
	Limnephilidae				
	Brachycentridae	*Brachycentrus*			
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*		81
	Gerridae				
Coleoptera	Dytiscidae	*Agabus*			
	Elmidae				
Diptera	Simuliidae				
	Culicidae				
	Chironomidae				
	Ceratopogonidae				
			TOTAL	32	

Biologist Clay Total Number of Taxa 7 Dall-mayfly

J = 2.03

Heptagenia elegantula 23 mm Not used

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 1517

Station No. E-4 Sample No. 4 Sampling Method SURBER Collection Date IX-24-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagena*	*elegantula*	24	1
		Rhithrogena	*undulata*	4	6
		STENONEMA (2)		21	
	Baetidae	*Baetis*	*bicaudatus*		15
		PSEUDOCLOEON *Callibaetis*		9	
		Ephemerella		1	
		Trichorythodes	*minutus* (?)	1	36
		Lachlania			
		Traverella	*albertana*	4	27
Odonata	Gomphidae	*Gomphus*	*intricatus*		43
		Ophiogomphus	*severus*		45
	Libellulidae				
	Aeschnidae				
Plecoptera	Perlodidae	*Isogenus*			
		Arcynopteryx			
	Perlidae	*Taenionema*	*pacifica*		65
		Acroneuria			
Trichoptera	Hydropsychidae	*Hydropsyche*			
	Limnephilidae				
	Brachycentridae	*Brachycentrus*			
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*		81
	Gerridae				
Coleoptera	Dytiscidae	*Agabus*			
	Elmidae				
Diptera	Simuliidae		Pupa	1	
	Culicidae				
	Chironomidae	unident Chironomus		1	
	Ceratopogonidae			1	
			TOTAL	47	

Biologist CR Total Number of Taxa 10

collected at upper end of bar 175± meters

taken on 4 other riffles / V

No Rhithrogena - omission! / V

Also 4 on summary sheet

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 1517

ction No. E-4 Sample No. 6 Sampling Method Surb Collection Date IX-24-75

ORDER	FAMILY	GENUS	SPECIES		NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagena*	*elegantula*	61	61	1
		Rhithrogena	*undulata*		0 NOTE	6
	Baetidae	*Baetis*	~~sp. A~~ *tricaudatus*	42	42	15
			sp. B		1	
		Callibaetis	*coloradensis*	5	5	
		Dactylobaetis				
		Ephemerella				
		Pseudocloeon	*turbidum*		42	
		Trichorythodes	*minutus*			36
		Lachlania				
		Traverella	*albertana*	23	23	27
Odonata	Gomphidae	*Gomphus*	*intricatus*			43
		Ophiogomphus	*severus*	2	2	45
		Hetaerina			1	
	Libellulidae					
	Aeschnidae					
ptera	Perlodidae	*Isogenus*				
		Arcynopteryx				
	Perlidae	*Taeniopteryx*	*pacifica*			65
		Acroneuria				
Trichoptera	Hydropsychidae	*Hydropsyche*		7	7	
	Limnephilidae					
	Brachycentridae	*Brachycentrus*				
	Leptoceridae	*Leptocella*		5	5	
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*			81
	Gerridae					
Coleoptera	Dytiscidae	*Agabus*				
	Elmidae					
Diptera	Simuliidae					
	Culicidae					
	Chironomidae				7 2	
	Ceratopogonidae					
				TOTAL	149	

Biologist C Ray Total Number of Taxa 10

J=2.23 ~~1~~ 2

Liston summary as 5

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 1517-1

Station No. E-4 Sample No. (7) Sampling Method SURBER Collection Date 8-24-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagenia*	*elegantula*	45+46+24+1 ~~45~~ 59	1
		Rhithrogena	*undulata*		
	Baetidae	*Baetis*	SpA 1+1	2	6
		Pseudocloeon	*turbidum* ~~29~~ 27+28+1	~~29~~	15
		Dactylobaetis	*cepheus* 4	~~7~~ 4	
	Ephemerellidae	*Ephemerella*			
	Trichorythidae	*Trichorythodes*	*minutus* 2	2	
			edmundsi 2	2	36
	Oligoneuriidae	*Lachlania*	*saskatchewanensis*		27
	Leptophlebiidae	*Traverella*	*albertana* 42+4	46	
		CHOROTERPES		~~5~~ 6	
					43
Odonat	Gomphidae	*Ophiogomphus*	*severus* 3-1	~~3~~ 4	45
	Libellulidae				
	Aeschnidae				
Plecoptera	Perlodidae	*Isogenoides*	1	1	
		Arcynopteryx			
	Perlidae	*Taeniopteryx*	*pacifica*		65
		Acroneuria			
Trichoptera	Hydropsychidae	*Hydropsyche*	2	2	
	Limnephilidae				
	Brachycentridae	*Brachycentrus*			
	LEPTOCERIDAE	*LEPTOCELLA*	sp 3	3	
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*		81
	Gerridae				
Coleoptera	Dytiscidae	*Agabus*			
	Elmidae				
Diptera	Simuliidae				
	Culicidae				
	Chironomidae		2	5	
	Ceratopogonidae				
		~~Tanytarsus~~	2	2	
			TOTAL	164	

many empty Leptocella cases!

Biologist [signature] Total Number of Taxa 14

$\bar{d} = 2.54$

appear ... last three weeks.

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 1517

Station No. F-11 Sample No. 1 Sampling Method Surber Collection Date IX-24-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagenia*	*elegantula*	31	1
		Rhithrogena	*undulata*	2	
	Baetidae	*Baetis*	sp (2 tails	13	6
		Pseudocloeon	*turbidum*		15
		Dactylobaetis	*cepheus*		
	Ephemerellidae	*Ephemerella*		1/2	
	Trichorythidae	*Trichorythodes*	23	24	
	Oligoneuriidae	*Lachlania*	*saskatchewanensis*		36
	Leptophlebiidae	*Traverella*	*albertana* 54	54	27
		Choroterpes			43
Odonata	Gomphidae	*Ophiogomphus*	*severus*	8 all small	45
	Libellulidae				
	Aeschnidae				
	Agrionidae	*Hetaerina*	sp (only 1)	1	
Plecoptera	Perlodidae	*Isogenus*			
		Arcynopteryx			
	Perlidae	*Taeniopteryx*	- *pacifica*		65
		Acroneuria	*abnormis* (only 1)		
Trichoptera	Hydropsychidae	*Hydropsyche*		18	
	Hydropsychidae			1	
	Limnephilidae				
	Brachycentridae	*Brachycentrus*			
	Leptoceridae	*Leptocella*		5	
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*		81
	Gerridae				
Coleoptera	Dytiscidae	*Agabus*			
	Elmidae	*Zaitzevia* * (?)		3	
Diptera	Simuliidae				
	Culicidae				
	Chironomidae				
	Ceratopogonidae				
	Ephydridae			3	
			TOTAL	170	

* very small ~2 mm

Biologist C Fay Total Number of Taxa 17

Lachlania - pluvial - emergence over?

Qual only

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 2

Station No. E-5 Sample No. 2 Sampling Method SCREEN Collection Date EX-30-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagena*	*elegantula*		1
		Rhithrogena	*undulata*		6
	Baetidae	*Baetis*	~~*bicaudatus*~~		15
		Callibaetis			
		Ephemerella			
		Trichorythodes	~~*minutus*~~		36
		Lachlania			
		Traverella	*albertana*		21
Odonata	Gomphidae	*Gomphus*	*intricatus*		43
	large	*Ophiogomphus*	*severus*		45
	Libellulidae				
	Aeschnidae				
Plecoptera	Perlodidae	*Isogenus/DES*			
		Arcynopteryx			
	Perlidae	*Taenionema*	*pacifica*		65
		Acroneuria			
Trichoptera	Hydropsychidae	*Hydropsyche*		44	
	Limnephilidae				
	Brachycentridae	*Brachycentrus*			
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*		81
	Gerridae				
Coleoptera	Dytiscidae	*Agabus*			
	Elmidae				
Diptera	Simuliidae				
	Culicidae				
	Chironomidae				
	Ceratopogonidae				
			TOTAL		

Biologist _____ Total Number of Taxa _____

Sample from meander

Titles on S-1 on Summary

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 1517

Station No. E-5 Sample No. 2 Sampling Method Surber Collection Date 7-24-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagena*	*elegantula* IIII	6	1
		Rhithrogena	*undulata* I	1	6
	Baetidae	Baetis + Ecclisocloeon	*bicaudatus* III	3	15
		Dactylobaetis	II	2	
		Callibaetis			
		Ephemerella			
		Trichorythodes	~~minutus~~ I	1	36
		Lachlania			
		Traverella	*albertana* 12	12	27
		Choroterpes	Albiannulata	1	
Odonata	Gomphidae	*Gomphus*	*intricatus*		43
		Ophiogomphus	*severus* 2 small	2	45
	Libellulidae				
	Aeschnidae				
Plecoptera	Perlodidae	Isogenoides	~~frontalis~~	5	
		Arcynopteryx			
	Perlidae	*Taenionema*	*pacifica*		65
		Acroneuria			
Trichoptera	Hydropsychidae	*Hydropsyche*			
	Limnephilidae				
	Brachycentridae	*Brachycentrus*			
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*		81
	Gerridae				
Coleoptera	Dytiscidae	*Agabus*			
	Elmidae				
Diptera	Simuliidae		I	1	
	Culicidae				
	Chironomidae				
	Ceratopogonidae				
			TOTAL	~~22~~ 34	

Biologist Clay Total Number of Taxa ~~10~~ 10

collected from meander $d = 2.77$

Just as 2 on Assembly

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 1517

Station No. E-5 Sample No. (3) Sampling Method Surber Collection Date IX-30-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagena*	*elegantula* 11	11	1
		Rhithrogena	*undulata* 1	1	6
	Baetidae	~~*Baetis*~~ Pseudocloeon	*bicaudatus* 13	13	15
		Callibaetis			
		Ephemerella	1	1	
		Trichorythodes	~~*minutus*~~ *edmundsi*	1	36
		Lachlania			
		Traverella	*albertana* 6		27
Odonata	Gomphidae	*Gomphus*	*intricatus*		43
		Ophiogomphus	*severus*		45
	Libellulidae				
	Aeschnidae				
Plecoptera	Perlodidae	*Isogenus*			
		Arcynopteryx			
	Perlidae	*Taeniopteryx*	*pacifica*		65
		Acroneuria			
Trichoptera	Hydropsychidae	*Hydropsyche*		5	
		Cedrocella		5	
	Limnephilidae				
	Brachycentridae	*Brachycentrus*			
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*		81
	Gerridae				
Coleoptera	Dytiscidae	*Agabus*			
	Elmidae				
Diptera	Simuliidae				
	Culicidae				
	Chironomidae				
	Ceratopogonidae				
	Ephydridae			1	
			TOTAL	38	

Biologist [signature] Total Number of Taxa 8

collected in meander $\bar{d} = 2.37$

Field data on summary table

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 4512-4

Station No. E-5 Sample No. (4) Sampling Method Surber Collection Date IX-30-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagena*	*elegantula* 104	104	1
		Rhithrogena	*undulata* 3	3	6
	Baetidae	*Baetis*	*bicaudatus* ~~26~~	62	15
		Callibaetis			
		Ephemerella	11	2	
		Trichorythodes	*minutus*		36
		Lachlania			
		Traverella	*albertana* 65	65	27
Odonata	Gomphidae	*Gomphus*	*intricatus*		43
		Ophiogomphus	*severus* 1	1	45
	Libellulidae				
	Aeschnidae				
Plecoptera	Perlodidae	*Isogenoides*	~~84~~	4	
		Arcynopteryx			
	Perlidae	*Taenionema*	*pacifica*		65
		Acroneuria			
Trichoptera	Hydropsychidae	*Hydropsyche*	7	7	
	Limnephilidae				
	Brachycentridae	*Brachycentrus*	1	1	
		Leptocella	1	1	
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*		81
	Gerridae				
Coleoptera	Dytiscidae	*Agabus*			
	Elmidae				
Diptera	Simuliidae				
	Culicidae				
	Chironomidae		pupa	1	
	Ceratopogonidae				
			TOTAL	185	

Biologist [illegible] Total Number of Taxa 11

collected at bank opposite lower end of meander

T=1.77

& Pseudocloeon. Removed ↑ Picked as 4 on Summary table

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 1512-17

tion No. F-5 Sample No. (5) Sampling Method SURBER Collection Date IX-30-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE 4			CODE NO.
Ephemeroptera	Heptageniidae	*Heptagena*	*elegantula*	54	54	54	1
		Rhithrogena	*undulata*	7	7	7	6
	Baetidae	*Baetis*	~~*bicaudatus*~~	1	1	1	15
		~~*Callibaetis*~~					
		Pseudocloeon	~~*edc*~~	~~2~~	22	22	
		Ephemerella			7	7	
		~~*Leptophlebia*~~ (?)			(8)	8	
		Trichorythodes	*minutus*	8	22 4	22 4	36
		Lachlania					
		~~223~~ *Traverella*	*albertana*	~~2 2 2 2 2~~			27
Odonata	Gomphidae	*Gomphus*	*intricatus*				43
		Ophiogomphus	*severus*	≥3	3	3	45
	Libellulidae						
	Aeschnidae						
~~Plecoptera~~	Perlodidae	*Isogenoides*		3	3	3	
		Arcynopteryx					
	Perlidae	*Taenionema*	*pacifica*				65
		Acroneuria					
Trichoptera	Hydropsychidae	*Hydropsyche*		7	7	7	
	Limnephilidae						
	Brachycentridae	*Brachycentrus*					
	Leptoceridae	*Leptocella*		1	1	1	
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*				81
	Gerridae						
Coleoptera	Dytiscidae	*Agabus*					
	Elmidae						
Diptera	Simuliidae						
	Culicidae						
	Chironomidae	~~*Chironomus*~~			3 1	2 1	
	Ceratopogonidae					340	
					TOTAL		~~348~~ 340

+ Tabulation in error, should be (?)

Biologist Clay Total Number of Taxa 13

collected on Bar inside bend = 1.79

listidas 5-50 summary table

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 1217

ion No. F-5 Sample No. (6) Sampling Method Surber Collection Date IX-30-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagena*	*elegantula*	21	1
		Rhithrogena	*undulata*	7	6
	Baetidae	*Baetis*	*bicaudatus*		15
		Callibaetis			
		Pseudocloeon		1	
		Ephemerella			
		Trichorythodes	*minutus*	3	36
		Lachlania			
		Traverella	*albertana*	63	27
Odonata	Gomphidae	*Gomphus*	*intricatus*		43
		Ophiogomphus	*severus*	2	45
	Libellulidae				
	Aeschnidae				
Plecoptera	Perlodidae	*Isogenus*			
		Arcynopteryx			
	Perlidae	*Taenionema*	*pacifica*		65
		Acroneuria			
Trichoptera	Hydropsychidae	*Hydropsyche*		1	
	Limnephilidae				
	Brachycentridae	*Brachycentrus*			
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*		81
	Gerridae				
Coleoptera	Dytiscidae	*Agabus*			
	Elmidae				
Diptera	Simuliidae				
	Culicidae				
	Chironomidae				
	Ceratopogonidae				
			TOTAL	103	

Biologist A Fay Total Number of Taxa 7

$d = 1.5 \text{ K}$

collected on Dan above gas well

D. AQUATIC BIOLOGY
5. QUANTITATIVE PLANKTON

QUANTITATIVE PLANKTON DATA July, 1974

50 millimeter strip counts (Enumeration factor = 5)

F-1 Alpha sample #1 50 ml. concentrate

Collected July 20, 1975

Cell #1

Strip	Count
1	23
2	18
3	22
4	11
	74

74X 5= 370 cells / ml. concentrate. .

370 cells / ml. X 50 ml. concentrate = 18,500 cells / 2200 ml. sample, or

8.4 cells / ml. water.

Cell #2

Strip	Count
1	22
2	17
3	16
4	13
	68

68 X 5 = 340 cells / ml. concentrate, or

7.7 cells/ ml. water

Cell #3

~~Strip #3~~	Count
1	25
2	26
3	15
4	24
	90

90 X 5 = 450 cells / ml. concentrate, or
10.2 cells / ml. water

F - 2 Alpha sample # 1 — 50 ml. concentrate

collected July 23, 1975

Cell # 1

Strip	Count
1	15
2	18
3	14
4	14
	61

61 X 5 = 310 cells / ml/concentrate, or

7 cells / ml. water

Cell # 2

Strtrip	Count
1	14
2	9
3	9
4	13
	45

45 X 5 = 225 cells / ml. concentrate, or

5.1 cells / ml water

Cell # 3

Strip	count
1	12
2	18
3	19
4	17
	66

66 X 5 = 330 cells / ml. concentrate, or

7.5 cells / ml. water

F-3 Alpha sample # 1

56.6 ml concentrate

Collected July 19, 1975

Cell #1

Strip	Count
1	12
2	17
3	20
4	16
	65

65 X 5 = 325 cells / ml. concentrate, or

8.4 cells / ml water

Cell #2

1	25
2	11
3	10
4	22
	68

68 X 5 = 340 cells / ml. concentrate, or

8.7 cells / ml. water

Cell #3

1	17
2	7
3	10
4	13
	47

47 X 5 = 235 cells / ml. concentrate, or

6.0 cells / ml. water

F-4 Alpha sample #3 — 55 Ml. concentrate

Collected July 24, 1975

Cell # 1

Strip	Count
1	15
2	15
3	17
4	11
	58

58 X 5 = 290 cells / ml. concentrate, or

7.25 cells / ml. water

Cell #2

1	12
2	20
3	9
4	8
	49

49 X 5 = 245 cells / ml. concentrate, or

6.1 cells / ml. water

Cell #3

1	6
2	7
3	11
4	14
	38

38 X 5 = 190 cells / ml . concentrate, or

4.7 cells / ml. water

F-5 Alpha sample #3 — 85.6 ml concentrate

Collected July 22, 1975

Cell #1

Strip	count
1	6
2	9
3	17
4	9
	41

41 X 5 = 210 cells / ml. concentrate, or

8.2 cells / ml. water

Cell #2

1	8
2	11
3	3
4	13
	35

35 X 5 = 175 cells / ml. concentrate, or

6.8 cells / ml. water

1	10
2	16
3	7
4	11
	44

44 X 5 = 220 cells / ml. concentate or

8.6 cells / ml. water

F- 6 Alpha sample # 1 200 ml concentrate

Cell #1

Strip	Count
1	528
2	749
3	814
4	636
	2727

2727 X 5 = 13, 635 cells / ml. concentrate, or

1240 cells / ml. water

The density of cells (all diatoms) in this sample made further counting impractical. The sample consisted of species of Pleurosigma Navicula, and Synedra , in that approximate order of abundance. Other species were extremely rare in the sample.

PLANKTON

Quantitative plankton analysis was conducted in accordance with Standard Methods for the Examination of Water and Wastewater, U.S. Public Health Service, 13th Ed., Section 601D. Plankton was collected with a Wildco alpha type sampler at a depth midway between the bottom and the surface. The material was strained through a # 16 silk bolting cloth and preserved in formalin.

Station F-1 October 10, 1974

Strip counts (50 ~~MM~~ mm^2 each strip)

Strip	count
1	53
2	101
3	229
4	118
total	501

Genera present

Filamentous algae	Diatoms
Cladophora	Cocconeis
Rhizoclonium	Cymbella
Spirogyra	Diatoma
	Navicula
	Surirella
	Gomphonema
	Gyrosigma
	Schroderia setigera

~~Enumeration factor = 5~~ ~~501 X 5 = 2505 cells/ ml concentrate.~~

~~25 ml sample X 2505 cells/ ml = 62,625 cells per sample~~

~~2200 ml per original sample~~ 28+ cells or filaments per milliliter water.

~~Spirogyra sp. — 10 cells/ml. concentrate~~
others unidentifiable ~~due to dessication~~; 200 cells/ ml. concentrate

Station F-2

strip	Count
1	27
2	11
3	17
4	8
total	63

Genera Present

filamentous algae ~~Diatoms~~

Spirogyra sp. 35 cells/ml
Ulothrix sp. 10 cells/ml
Vaucheria sp. 5 cells/ml
~~diatoms~~

Tabellaria sp. 20 cells/ml

Unidentifiable cells 260/ml

~~Enumeration factor = 5. 63 X 5 = 315 cells/ml.~~ ~~315 cells/ml X 50 ml = 15,750~~ ~~cells per sample (2200 ml sample)~~ 7.2 cells ml water

Station F-3

Strip	Count
1	12
2	11
3	12
4	7
	42

Genera present
Spirogyra the only recognizable organism: about 10 cells/ml. of the concentrated sample.

~~Enumeration factor = 5~~ ~~42 X 5 = 210 cells/ml in concentrate.~~
~~50 ml. sample X 210 cells/ml.~~ → 10,500 cells/~~in entire~~ 2200 ml. sample: about 5 cells per milliliter water

Station F-4

Strip	Count
1	27
2	17
3	15
4	17
	76

Genera present
Cladophora : 12 cell/ml. concentrate.
Cocconeis : 8 cell/ml. concentrate
Navicula : 3 cell/ml. concentrate

~~Enumeration factor = 5.~~ ~~76 X 5 =~~ 380 cells/ml. concentrate.
~~380 cells/ml. X 50 ml. concentrate =~~ ~~20,000~~ 19,000 cells in the sample, or about ~~8.6~~ 8.6 cells per milliliter of water.

Station F-5

Strip	Count
1	22
2	31
3	29
4	27
	109

Enumeration factor = 5. 109 X 5 = 545 cells/ml of concentrate.

50 ml. concentrate X 545 cells/ml. concentrate = 27, 250 cells per entire sample, or 125 cells/ ml. in the original sample.

Genera present

Unidentified	198/ ml.
Cladophora	76/ ml.
Nasicula	41/ml.
Spirogyra	41/ ml.
Diatoms	41/ml.
Chlorella	14/ml.
Euglena	14/ml.
Rhizoclonium	7/ml.
Gyrosigma	7/ml.
Gomphonema	7/ml.
Scroderia setigera	7/ml.
Ceratium	7/ml
Tabellaria	7/ml.

Oct

Station F-6 (Evacuation Creek) November 12, 1974

Only qualitative collections were made in Evacuation Creek. Current was inadequate for the use of a Surber sampler; substrate was too coarse to permit proper operation of the Ekman dredge. Insects were handpicked or captured with a hand plankton net.

Agabus sp. Dytiscidae, (Coleoptera) common

Limnophora aequifrons (Anthyomiidae, Diptera) abundant

Baetis sp. (Baetidae, Ephemeroptera) abundant

Corixa sp. (Corixidae, Hemiptera) Common

Limnephilidae (Trichoptera) common. These are found only on the submerged undersides of shale ledges.

Culex salinarius (Culicidae, Diptera) Common

Callibaetis sp. Common.

Simulium sp. (Simuliidae, Diptera) Abundant

Tabanus sp. (Tabanidae, Diptera) Rare

Station F-6 Evacuation Creek Algae

The following genera of algae were collected in Evacuation Creek on several dates during October and Novermber, 1974.

Mougeotia
Cocconeis
Ulothrix
Microspora
Zygnema
Cymbella
Stauroneis
Navicula
Merismopedia
Synedra
Fragilaria
Euglena

The genera are listed in their approximate order of abundance. Only one, or a few specimens of the last three genera were observed.

F-1 QUANTITATIVE PLANKTON

Collected IV-1-75

Examined IV-7-75 (25 ml concentrate)

50 mm. strip counts (Enumeration factor = 5)

Cell #1	Number
1	60
2	57
3	50
4	43
	210

210 = 1050/ml x 25 ml = 26,250/2200 ml = 12 cells ml.

Cell #2	Number
1	28
2	68
3	40
4	68
	204

1020/ml x 25 ml = 25,500/2200 ml = 11.6 cells/ml

Cell #3	Number
1	20
2	24
3	39
4	25
	108

540/ml x 25 ml = 13,500/2200 ml = 6.1/ml

$\bar{X}$ = 9.9 cells/ml

Genera not noted in alqal collections:

Spirulina (subsalsa?)

Gyrosigma sp.

Schroderia setigera

F-2 QUANTITATIVE PLANKTON

Collected IV-3-75

Examined IV-3-75 (25 ml concentrate)

Cell #1	Number
1	57
2	56
3	49
4	23
	185

925/ml x 25 ml = 23,125 cells/2200 ml = 10.5 cells/ml

Cell #2	Number
1	28
2	57
3	25
4	30
	140

700 cells/ml x 25 ml = 17,500/2200 ml = 8 cells/ml.

Cell #3	Number
1	35
2	65
3	33
4	41
	174

870 cells/ ml x 25 ml = 21,750 cells/ 2200 ml = 9.9 cells/ ml

$\bar{X}$ = 9.95 cells/ml.

F-3 QUANTITATIVE PLANKTON

Collected IV-1-75

Examined IV-7-75 (25 ml concentrate)

Cell #1	Number
1	33
2	23
3	19
4	26
	101

505 cells/ml x 25 ml = 12,625/2200 ml = 5.7 cells/ml

Cell #2	Number
1	22
2	18
3	25
4	16
	81

405 cells/ml x 25 ml = 10,125 cells/2200 ml = 4.6 cells/ml

Cell #3	Number
1	24
2	14
3	14
4	15
	67

335 cells/ml x 25 ml = 8,375 cells/2200 ml = 3.8 cells/ml.

$\bar{X}$ = 4.7 cells/ml

F-4 QUANTITATIVE PLANKTON

Collected IV-2-75

Examined IV-7-75 (50 ml concentrate)

Cell #1	Number
1	24
2	28
3	57
4	34
	143

715 cells/ml x 50 ml = 35,750 cells/2200 ml = 16.2 cells/ml

Cell #2	Number
1	28
2	43
3	65
4	48
	164

820 cells/ml x 50 ml = 41,000 cells/2200 ml = 18.6 cells/ml.

Cell #3	Number
1	53
2	55
3	82
4	67
	257

1285/ml x 50 ml = 64,250 cells/2200 ml = 29.2 cells/ml

$\bar{X}$ = 21.3 cells/ml

tabellaria floculosa present.

F-5 QUANTITATIVE PLANKTON

Collected IV-2-75

Examined IV-7-75 (25 ml concentrate)

Cell #1	Number
1	52
2	60
3	51
4	34
	197

985 cells/ml x 25 ml = 24,625/2200 ml = 11.2 cells/ml

Cell #2	Number
1	56
2	60
3	60
4	45
	221

1105/ml x 25 ml = 27,625/2200 ml = 12.6 cells/ml

Cell #3	Number
1	49
2	61
3	64
4	57
	231

1155 cells/ml x 25 ml = 28,875 cells/2200 ml = 13.1 cells/ml.

$\bar{X}$ = 12.3 cells/ml.

Fish collected from immediately upstream of the Bitter Creek confluence (DWR Station 5), November 20,1975.

No.	Name	Standard Length SL (mm)	Weight grams	Condition factor K_{SL}
1	Catostomus latipinnis	298	452	1.71
2	" "	117	36.7	2.29
3	" "	116	24.0	1.54
4	" "	98	17.5	1.86
5	" "	82	13.8	2.50
6-21 (16)	" "	20 (average)	27.7 (total)	----
22-28 (7)	Pimepheles Promelas	20 (average)	6.7 (total)	----
29-404 (375)	Notropis lutrensis		121.5 (total)	----
405-495 (91)	Rhinichthys osculus		97.1 (total)	----

495 total

Fish collected on leased agricultural area near east boundary of Indian land (DWR Station 6), November 20, 1975.

1	Cyprinus carpio	220	416.4	3.9
2	" "	248	672.7	4.4
3	" "	247	712.7	4.7
4	Gila robusta	210	186.8	2.02
5	" "	52	2.1	1.50
6	" "	153	62.9	1.75
7	Catostomus latipinnis	186	156.7	2.44
8	" "	57	4.6	2.48
9-15 (7)	Notropis lutrensis	53	3.4	3.49
10	" "	46	3.0	3.09
11	" "	34	0.9	2.29
12	" "	32	0.9	2.74
13	" "	35	1.1	2.57
14	" "	33	0.9	2.50
15	" "	24	0.6	4.3
16	Unidentifiable larva (Notropis ?)			

The collection also contained one Dytiscus ooligbukii

Fish collected at the Mountain Fuel Supply Bridge (DWR Station 7), November 21, 1975.

No.	Name	SL (mm)	grams	K_{SL}
1	Catostomus latipinnis	61	3.8	1.67
2	" "	51	2.7	2.04
3	" "	58	3.0	1.54
4	" "	45	1.3	1.43
5	" "	33	0.3	0.83
6	" "	41	0.7	1.89
7	" "	47	1.4	1.35
8	Rhinichthys osculus	64	5.0	1.91
9	" "	57	3.2	1.73
10	" "	48	2.1	1.90
11	" "	45	1.6	1.76
12	" "	49	1.7	1.44
13	" "	49	1.6	1.36
14	" "	52	2.4	1.71
15	" "	45	1.35	1.48
16	" "	37	0.45	0.89
17	" "	45	1.45	1.59
18	" "	36	0.65	1.39
19	" "	1.8	0.02	0.34
20-298	Notropis lutrensis			
298 total				

Notropis lutrensis-- 24 fish selected at random from the above collection

SL (mm)	Wt. (grams)	K_{SL}
29	0.35	1.44
34	0.7	1.78
32	0.6	1.83
29	0.45	1.84
28	0.35	1.59
47	2.0	1.92
32	0.6	1.93
29	0.5	2.05
32	0.6	1.83
37	1.25	2.47
28	0.35	1.59
28	0.4	1.82
22	0.2	1.88
21	0.12	1.94
27	0.35	1.78
25	0.30	1.52
27	0.35	1.78
24	0.32	2.31
27	0.4	2.03
26	0.4	2.26
22	0.25	0.35
24	0.27	1.95
20	0.15	0.63
27	0.22	1.12
$\bar{X}$ = 28.3	$\bar{X}$ = 0.48	$\bar{X}$ = 1.78

Fish collected at White River bridge near Ouray, Utah (DWR Station 8), November 21,1975.

No.	Name	SL (mm)	Grams	K_{SL}
1-157	Notropis lutrensis	-----	---	----
158-161	Cyprinus carpio	-----	---	----
162	Ictalurus punctatus	88	12.2	1.79
163-182	" "	-----	24.0 (total)	---
183	Salmo trutta	88	13.2	1.94
184	Catostomus latipinnis	187	132	2.02
185-201	Rhinichthys osculus		19.4 (total)	---

V. GEOLOGY AND SOILS

V. GEOLOGY AND SOILS - GEOLOGIC EXPLORATION REPORT

WHITE RIVER SHALE PROJECT

GEOLOGICAL INFORMATION SUBMITTED TO
VIN FOR THE 5TH QUARTERLY REPORT

DECEMBER, 1975

BY

THE CLEVELAND-CLIFFS IRON COMPANY

W. W. MOULTON

GEOLOGICAL ENGINEER

THE CLEVELAND-CLIFFS IRON COMPANY

WESTERN DIVISION OFFICE

Interoffice Memo

TO: P. W. McKie
Superintendent

FROM: W. W. Moulton
Geological Engineer

COPIES TO:

DATE: December 12, 1975

SUBJECT:

In summarizing the Geologic Exploration Plan in Quarterly Report No. 5, the following information will be made available to V.T.N.

1) Copies of Lithologic Logs.

2) Intervals tested for boron, mercury, cadmium, flouride, antimony, arsenic, selenium, molybdenum and nahcolite with results.

3) Intervals assayed and rock mechanics tested, results not required. — why not? are they done?

4) Approximate location of the mining zone within the bore holes.

5) Uinta-Green River contact pics.

The following sections contain the above material together with test results where required.

Wesley W Moulton

W. W. Moulton
Geological Engineer

WWM/vc
Attachment
12/12/75

THIS TRACE ELEMENT DATA IS VOID. DO NOT USE.

CORRECTED DATA AVAILABLE IN SIXTH QUARTERLY REPORT "FIELD DATA"

RAT

11
5
5
0
0
9
0
2
5
4
0

1) Copies of the original Lithologic Log are included with this report and follow the Uinta-Green River contact pics.

2) Samples from 100 foot intervals from holes X-2, X-3, X-4, X-5, X-6, X-9, X-10, and X-11 were analyzed for boron, mercury, cadmium, flouride, antimony, arsenic selenium and molybdenum. These tests were on samples of raw and spent shale. The samples of spent shale were analyzed for the portion of the elements that are water soluble and the total element contained. Raw shale was analyzed for the total element contained.

All results are in parts per million.

Results for spent shale total element contained. (Note Example X-2, 600 - 700).

HOLE NO.:	X-2	X-3	X-4	X-5	X-6	X-9	X-10	X-11
FOOTAGE INTERVAL TESTED (Feet)	600 -700	430 530	797 897	772 872	642 742	902 1002	932 1032	825 925
Boron	6	0	0	0	0	0	0	0
Mercury	16.6	19.0	22.0	23.0	22.0	20.0	19.0	20.0
Cadmium	0.17	0.16	0.18	0.17	0.20	0.18	0.19	0.19
*Flouride	450.0	105.0	100.0	105.0	105.0	105.0	100.0	450.0
Antimony	3.16	3.07	3.19	3.23	3.45	3.80	4.04	3.92
Arsenic	2	3	5	5	7	0	4	5
Selenium	0.07	0.06	0.055	0.11	0.06	0.06	0	0.04
Molybdenum	1.23	1.35	1.22	1.34	1.26	1.23	1.22	1.30

*Wes Moulton (ccic) told me that F all 10X.
Move all F decimals 1 place left

Ed
12/15/75

Results for spent shale water soluble elements:

Water Soluble

HOLE NO.:	X-2	X-3	X-4	X-5	X-6	X-9	X-10	X-11
FOOTAGE INTERVAL TESTED (Feet)	600 700	430 530	790 900	770 880	640 760	900 1010	930 1040	820 930
Boron	1.9	3.4	5.2	1.7	3.4	1.4	3.1	4.3
Mercury	1.2	0.9	0.5	0.8	0.6	0.4	0.4	0.09
Cadmium	0.01	0.03	0.02	0.01	0.02	0.01	0.02	0.01
Flouride	85.0	85.0	90.0	92.5	100.0	110.0	25.0	135.0
Antimony	.31	.16	.15	.22	.19	0.57	0.26	0.28
Arsenic	0	5	0	4	4	6	8	1
Selenium	0.01	0.03	0.02	0.02	0.005	0.01	0.03	0.01
Molybdenum	0.68	0.55	0.46	0.50	0.69	0.56	0.69	0.64

Raw Shale Total Element Contained

HOLE NO.:	X-2	X-3	X-4	X-5	X-6	X-9	X-10	X-11
FOOTAGE INTERVAL TESTED (Feet)	600 700	430 530	790 900	770 880	640 760	900 1010	930 1040	820 930
Boron ?	5.2	0	0	0	0	0	0	0
Mercury 100X	38.0	28.1	25.3	27.5	26.9	22.6	22.3	19.7
Cadmium	0.20	0.18	0.17	0.19	0.19	0.17	0.19	0.19
Flouride 1/10	100.0	115.0	100.0	135.0	150.0	190.0	1400.0	2950.0
Antimony	3.77	2.29	2.45	2.35	2.08	2.23	2.39	2.35
Arsenic 1/10	9	9.0	7.0	7.0	1.0	3.0	5.0	9.0
Selenium 1/10	0.11	0.15	0.10	0.11	0.13	0.15	0.11	0.12
Molybdenum 1/10	1.44	1.04	0.96	1.24	1.17	0.83	0.97	1.06

Samples from twenty-seven 100 foot intervals in Holes P-1, P-2, P-3, and P-4 were analyzed for boron, mercury, cadmium, flouride, antimony, arsenic and selenium. This analysis was made on raw shale for the total element contained. Results are given in parts per million.

	B	Hg	Cd	F	Sb	As	Se
P-1 HOLE:							
500-600	34.0	0.05	0.03	480.0	0.5	12.0	.26
6- 7	46.0	0.22	0.03	602.0	0.4	16.0	.36
7- 8	29.0	0.12	0.91	1658.0	0.4	10.0	.10
8- 9	6.0	0.12	0.68	1170.0	0.3	5.0	.14
9- 10	13.0	0.16	0.11	644.0	0.6	20.0	.37
10- 11	14.0	0.14	0.11	680.0	0.4	6.0	.27
11- 12	8.0	0.12	0.10	434.0	0.4	29.0	.30
P-2 HOLE:							
550-650	43.0	0.13	0.13	1115.0	0.3	23.0	.08
650-750	49.0	0.10	0.09	704.0	0.4	19.0	.20
750-850	13.0	0.08	0.16	1707.0	0.2	21.0	.26
850-950	28.0	0.08	0.04	319.0	0.4	61.0	.34
950-1050	26.0	0.22	0.04	705.0	0.3	39.0	.24
1050-1150	8.0	0.02	0.11	442.0	0.5	26.0	.20
1150-1250	28.0	0.07	0.08	886.0	0.4	23.0	.35
P-3 HOLE:							
560-670	29.0	0.10	0.19	598.0	0.3	22.0	.14
670-770	28.0	0.06	0.10	648.0	0.2	3.0	.28
770-870	24.0	0.11	0.14	762.0	0.3	15.0	.17
870-970	17.0	0.06	0.12	762.0	0.3	18.0	.20
970-1070	3.0	0.12	0.12	384.0	0.2	27.0	.35
1070-1170	10.0	0.03	0.05	412.0	0.2	11.0	.11

	B	Hg	Cd	F	Sb	As	Se
P-4 HOLE:							
460-560	33.0	0.21	0.14	680.0	0.4	25.0	.10
560-660	42.0	0.12	.09	894.0	0.6	24.0	.15
660-760	23.0	0.14	.13	655.0	0.4	16.0	.93
760-860	16.0	0.04	.08	516.0	0.3	10.0	.35
860-960	13.0	0.03	.11	428.0	0.2	11.0	.80
960-1060	8.0	0.02	.07	320.0	0.3	2.0	.35
1060-1160	7.0	0.03	.09	511.0	0.3	11.0	.23

Extractable alumina analyses on spent shale from the Pilot Test Holes and the Exploration Holes were completed on ten foot intervals. These results, which are attached, are in percent extractable alumina.

Occurrences of nahcolite noted in the drill hole lithologic logs were analyzed for sodium bicarbonate content.

Following are the results of X-ray defraction analyses for nahcolite.

HOLE NO. AND INTERVAL				% NAHCOLITE
P-2	(842.20 - 842.85)		.30	31%
X-11	(837.00 - 837.25)			-0-
X-4	(854.30 - 855.00)	.70	.315	45%
X-4	(853.70 - 854.10)	.40	.14	35%
X-4	(852.68 - 853.50)	.82	.14	17%
X-1	(1073.50 - 1073.75)			-0-
X-2	(661.50 - 663.75)	2.25	.555	38%
		4.72	1.65	= 35%

WHITE RIVER SHALE PROJECT

Extractable Alumina in Spent Shale

HOLE P-1

Footage Interval	% Al
490 - 500	0.320
500 - 510	0.317
510 - 520	0.453
520 - 530	0.598
530 - 540	0.208
540 - 550	0.260
550 - 560	0.265
560 - 570	0.193
570 - 580	0.238
580 - 590	0.008
590 - 600	0.265
600 - 610	0.240
610 - 620	0.227
620 - 630	0.171
630 - 640	0.835
640 - 650	0.198
650 - 660	0.214
660 - 670	0.192
670 - 680	1.500
680 - 690	0.118
690 - 700	0.062
700 - 710	0.063
710 - 720	0.054
720 - 730	0.201
730 - 740	0.201
740 - 750	0.233
750 - 760	0.164
760 - 770	0.173
770 - 780	0.070
780 - 790	0.086
790 - 800	0.132
800 - 810	0.230
810 - 820	0.598
820 - 830	0.978

HOLE P-1 Cont'd.

Footage Interval	% Al
830 - 840	0.874
840 - 850	1.449
850 - 860	1.120
860 - 870	0.938
870 - 880	0.496
880 - 890	0.552
890 - 900	0.757
900 - 910	0.586
910 - 920	0.859
920 - 930	1.210
930 - 940	1.312
940 - 950	1.393
950 - 960	2.058
960 - 970	1.447
970 - 980	1.175
980 - 990	1.274
990 - 1000	1.918
1000 - 1010	1.931
1010 - 1020	2.079
1020 - 1030	2.179
1030 - 1040	2.254
1040 - 1050	-
1050 - 1060	-
1060 - 1070	-
1070 - 1080	-
1080 - 1090	-
1090 - 1100	-
1100 - 1110	0.838
1110 - 1120	1.182
1120 - 1130	1.643
1130 - 1140	1.190
1140 - 1150	0.852
1150 - 1160	1.319
1160 - 1170	1.529
1170 - 1180	1.200

HOLE P-1 Cont'd.

Footage Interval	% Al
1180 - 1190	2.120
1190 - 1200	1.635
1200 - 1210	1.345
1210 - 1220	0.200

MM ≈

5279
4539
740

WHITE RIVER SHALE PROJECT
Extractable Alumina in Spent Shale

HOLE P-2

Footage Interval	% Al
570 - 580	0.141
580 - 590	0.143
590 - 600	0.141
600 - 610	0.141
610 - 620	0.073
620 - 630	0.098
630 - 640	0.146
640 - 650	0.188
650 - 660	0.214
660 - 670	0.263
670 - 680	0.173
680 - 690	0.193
690 - 700	0.148
700 - 710	0.212
710 - 720	0.154
720 - 730	0.146
730 - 740	0.157
740 - 750	0.200
750 - 760	0.093
760 - 770	0.101
770 - 780	0.090
780 - 790	0.101
790 - 800	0.081
800 - 810	0.170
810 - 820	0.104
820 - 830	0.137
830 - 840	0.080
840 - 850	0.064
850 - 860	0.070
860 - 870	0.081
870 - 880	0.085
880 - 890	0.070
890 - 900	0.095
900 - 910	0.655
910 - 920	0.100
920 - 930	0.177

HOLE P-2 Cont'd.

Footage Interval	% Al
930 - 940	0.161
940 - 950	0.208
950 - 960	0.163
960 - 970	0.120
970 - 980	0.076
980 - 990	0.234
990 - 1000	0.269
1000 - 1010	0.068
1010 - 1020	1.021
1020 - 1030	2.336
1030 - 1040	2.625
1040 - 1050	Lost Core
1050 - 1060	Lost Core
1060 - 1070	1.310
1070 - 1080	2.113
1080 - 1090	0.245
1090 - 1100	0.205
1100 - 1110	2.049
1110 - 1120	2.063
1120 - 1130	2.326
1130 - 1140	2.625
1140 - 1150	2.480
1150 - 1160	0.094
1160 - 1170	0.097
1170 - 1180	1.134
1180 - 1190	0.991
1190 - 1200	0.296
1200 - 1210	0.738
1210 - 1220	2.190
1220 - 1230	1.416
1230 - 1240	1.223
1240 - 1250	1.254
1250 - 1260	1.553
1260 - 1270	1.406
[illegible] - [illegible]	0.177

HOLE P-2 Cont'd.

Footage Interval	% Al
1270 - 1280	0.241
1280 - 1290	1.769

Note: Mahogany Marker at 819 ft.

WHITE RIVER SHALE PROJECT

Extractable Alumina in Spent Shale

HOLE P-3

Footage Interval	% Al
540 - 550	0.124
550 - 560	0.098
560 - 570	0.161
570 - 580	0.125
580 - 590	0.147
590 - 600	0.164
600 - 610	0.086
610 - 620	0.114
620 - 630	0.264
630 - 640	-
640 - 650	0.755
650 - 660	0.609
660 - 670	0.283
670 - 680	0.252
680 - 690	0.292
690 - 700	0.894
700 - 710	0.187
710 - 720	0.135
720 - 730	0.782
730 - 740	0.166
740 - 750	0.227
750 - 760	0.152
760 - 770	0.176
770 - 780	0.685
780 - 790	0.253
790 - 800	0.180
800 - 810	0.217
810 - 820	0.124
820 - 830	0.493
830 - 840	0.117
840 - 850	0.166
850 - 860	0.998
860 - 870	0.906

HOLE P-3 Cont'd.

Footage Interval	% Al
870 - 880	0.800
880 - 890	1.406
890 - 900	1.114
900 - 910	0.787
910 - 920	0.991
920 - 930	1.053
930 - 940	0.227
940 - 950	1.264
950 - 960	1.414
960 - 970	1.592
970 - 980	1.468
980 - 990	2.357
990 - 1000	2.591
1000 - 1010	1.944
1010 - 1020	1.570
1020 - 1030	2.264
1030 - 1040	2.862
1040 - 1050	2.783
1050 - 1060	2.070
1060 - 1070	2.340
1070 - 1080	3.016
1080 - 1090	2.657
1090 - 1100	2.025
1100 - 1110	1.060
1110 - 1120	0.907
1120 - 1130	1.378
1130 - 1140	0.735
1140 - 1150	0.866
1150 - 1160	2.268
1160 - 1170	1.754
1170 - 1180	1.411
1180 - 1190	1.613

HOLE P-3 Cont'd.

Footage Interval	% Al
1190 - 1200	1.984
1200 - 1210	1.941
1210 - 1220	2.672

Note: Mahogany Marker at 796 ft.

WHITE RIVER SHALE PROJECT
Extractable Alumina in Spent Shale

HOLE P-4

Footage Interval	% Al
450 - 460	0.174
460 - 470	0.574
470 - 480	1.160
480 - 490	0.300
490 - 500	0.921
500 - 510	0.260
510 - 520	0.220
520 - 530	0.779
530 - 540	0.901
540 - 550	0.800
550 - 560	1.196
560 - 570	0.886
570 - 580	0.761
580 - 590	0.822
590 - 600	0.262
600 - 610	0.914
610 - 620	0.804
620 - 630	0.902
630 - 640	1.445
640 - 650	0.241
650 - 660	0.195
660 - 670	0.162
670 - 680	0.107
680 - 690	0.856
690 - 700	0.722
700 - 710	0.516
710 - 720	0.179
720 - 730	0.093
730 - 740	0.290
740 - 750	0.280
750 - 760	0.260
760 - 770	1.057

HOLE P-4 Cont'd.

Footage Interval	% Al
770 - 780	0.816
780 - 790	1.320
790 - 800	1.190
800 - 810	0.792
810 - 820	0.562
820 - 830	1.420
830 - 840	0.973
840 - 850	1.220
850 - 860	0.870
860 - 870	1.870
870 - 880	2.070
880 - 890	1.640
890 - 900	3.000
900 - 910	2.280
910 - 920	2.050
920 - 930	1.317
930 - 940	2.112
940 - 950	2.253
950 - 960	1.763
960 - 970	2.572
970 - 980	2.700
980 - 990	2.949
990 - 1000	1.480
1000 - 1010	1.300
1010 - 1020	1.830
1020 - 1030	1.120
1030 - 1040	0.980
1040 - 1050	1.574
1050 - 1060	1.730
1060 - 1070	1.315
1070 - 1080	1.863

HOLE P-4 Cont'd.

Footage Interval	% Al
1080 - 1090	2.250
1090 - 1100	1.580
1100 - 1110	2.700
1110 - 1120	3.300
1120 - 1130	0.682
1130 - 1140	1.191
1140 - 1150	3.000
1150 - 1160	2.635
1160 - 1170	3.300

Note: Mahogany Marker at 703 ft.

WHITE RIVER SHALE PROJECT

Extractable Alumina in Spent Shale

HOLE X-1

Footage Interval	% Al
870 - 880	0.674
880 - 890	0.240
890 - 900	0.223
900 - 910	0.174
910 - 920	0.180
920 - 930	0.209
930 - 940	0.305
940 - 950	0.263
950 - 960	0.431
960 - 970	0.378
970 - 980	0.247
980 - 990	0.548
990 - 1000	0.402
1000 - 1010	0.193
1010 - 1020	0.292
1020 - 1030	0.253
1030 - 1040	0.211
1040 - 1050	0.264
1050 - 1060	0.292
1060 - 1070	0.291
1070 - 1080	0.576
1080 - 1090	0.620
1090 - 1100	0.241
1100 - 1110	0.172
1110 - 1120	0.523
1120 - 1130	0.320

Note: Mahogany Marker at 1003 ft.

WHITE RIVER SHALE PROJECT
Extractable Alumina in Spent Shale

HOLE X-2

Footage Interval	% Al
510 - 520	0.166
520 - 530	0.203
530 - 540	0.221
540 - 550	0.137
550 - 560	0.143
560 - 570	0.934
570 - 580	0.134
580 - 590	0.222
590 - 600	0.120
600 - 610	0.103
610 - 620	0.169
620 - 630	0.259
630 - 640	0.184
640 - 650	0.226
650 - 660	0.124
660 - 670	0.098
670 - 680	0.087
680 - 690	0.076
690 - 700	0.112
700 - 710	0.177
710 - 720	0.214
720 - 730	0.702
730 - 740	0.368
740 - 750	1.017
750 - 760	1.121

Note: Mahogany Marker at 641 ft.

WHITE RIVER SHALE PROJECT
Extractable Alumina in Spent Shale

HOLE X-3

Footage Interval	% Al
330 - 340	0.704
340 - 350	0.308
350 - 360	0.227
360 - 370	0.873
370 - 380	0.249
380 - 390	0.258
390 - 400	0.954
400 - 410	0.157
410 - 420	0.322
420 - 430	0.145
430 - 440	0.101
440 - 450	0.242
450 - 460	1.012
460 - 470	1.012
470 - 480	0.644
480 - 490	0.179
490 - 500	0.143
500 - 510	0.262
510 - 520	0.210
520 - 530	0.756
530 - 540	0.821
540 - 550	1.400
550 - 560	0.696
560 - 570	1.232
570 - 580	0.977
580 - 590	0.956

Note: Mahogany Marker at 470 ft.

WHITE RIVER SHALE PROJECT

Extractable Alumina in Spent Shale

HOLE X-4

Footage Interval	% Al
710 - 720	0.230
720 - 730	0.087
730 - 740	Lost Core
740 - 750	0.548
750 - 760	1.800
760 - 770	0.230
770 - 780	0.330
780 - 790	0.086
790 - 800	0.087
800 - 810	0.130
810 - 820	0.726
820 - 830	0.260
830 - 840	0.264
840 - 850	0.144
850 - 860	0.130
860 - 870	0.108
870 - 880	0.186
880 - 890	0.183
890 - 900	0.312
900 - 910	0.703
910 - 920	0.627
920 - 930	0.617
930 - 940	2.262
940 - 950	1.018

Note: Mahogany Marker at 837 ft.

WHITE RIVER SHALE PROJECT
Extractable Alumina in Spent Shale

HOLE X-5

Footage Interval	% Al
680 - 690	0.686
690 - 700	1.045
700 - 710	0.619
710 - 720	0.254
720 - 730	1.180
730 - 740	0.246
740 - 750	0.864
750 - 760	0.322
760 - 770	0.195
770 - 780	0.164
780 - 790	0.270
790 - 800	0.591
800 - 810	0.764
810 - 820	0.196
820 - 830	0.109
830 - 840	0.619
840 - 850	0.240
850 - 860	0.590
860 - 870	0.760
870 - 880	0.250
880 - 890	0.994
890 - 900	1.808
900 - 910	1.340
910 - 920	2.700
920 - 930	1.625

Note: Mahogany Marker at 812 ft.

WHITE RIVER SHALE PROJECT
Extractable Alumina in Spent Shale

HOLE X-6

Footage Interval	% Al
540 - 550	0.904
550 - 560	0.570
560 - 570	0.192
570 - 580	0.552
580 - 590	0.300
590 - 600	0.190
600 - 610	1.300
610 - 620	0.300
620 - 630	0.552
630 - 640	0.477
640 - 650	0.313
650 - 660	0.674
660 - 670	0.955
670 - 680	0.812
680 - 690	0.588
690 - 700	0.160
700 - 710	0.090
710 - 720	0.174
720 - 730	0.223
730 - 740	0.894
740 - 750	0.228
750 - 760	1.407
760 - 770	1.220
770 - 780	1.180
780 - 790	1.521
790 - 800	0.844

Note: Mahogany Marker at 682 ft.

WHITE RIVER SHALE PROJECT

Extractable Alumina in Spent Shale

HOLE X-9

Footage Interval	% Al
810 - 820	0.251
820 - 830	0.572
830 - 840	0.300
840 - 850	0.160
850 - 860	-
860 - 870	-
870 - 880	-
880 - 890	0.113
890 - 900	0.162
900 - 910	0.576
910 - 920	0.287
920 - 930	0.275
930 - 940	0.217
940 - 950	0.191
950 - 960	0.228
960 - 970	0.140
970 - 980	0.182
980 - 990	0.280
990 - 1000	0.290
1000 - 1010	1.205
1010 - 1020	0.807
1020 - 1030	1.204

Note: Mahogany Marker at 944 ft.

WHITE RIVER SHALE PROJECT
Extractable Alumina in Spent Shale

HOLE X-10

Footage Interval	% Al
840 - 850	0.818
850 - 860	0.917
860 - 870	0.262
870 - 880	0.740
880 - 890	0.191
890 - 900	0.207
900 - 910	0.259
910 - 920	1.320
920 - 930	0.252
930 - 940	0.243
940 - 950	0.193
950 - 960	0.836
960 - 970	0.206
970 - 980	0.180
980 - 990	0.176
990 - 1000	0.170
1000 - 1010	0.104
1010 - 1020	0.130
1020 - 1030	0.187
1030 - 1040	0.214
1040 - 1050	0.825
1050 - 1060	0.285
1060 - 1070	0.755
1070 - 1080	0.258
1080 - 1090	0.298
1090 - 1100	1.206

Note: Mahogany Marker at 972 ft.

WHITE RIVER SHALE PROJECT
Extractable Alumina in Spent Shale

HOLE X-11

Footage Interval	% Al
730 - 740	0.815
740 - 750	0.804
750 - 760	0.908
760 - 770	0.704
770 - 780	0.645
780 - 790	0.831
790 - 800	1.470
800 - 810	0.220
810 - 820	0.564
820 - 830	0.234
830 - 840	0.282
840 - 850	0.668
850 - 860	0.557
860 - 870	0.216
870 - 880	0.243
880 - 890	0.172
890 - 900	0.197
900 - 910	0.136
910 - 920	0.160
920 - 930	0.199
930 - 940	0.295
940 - 950	0.970
950 - 960	1.592
960 - 970	0.833
970 - 980	0.861
980 - 990	0.936

Note: Mahogany Marker at 866 ft.

3) Footage intervals assayed and rock mechanics tested are as follows:

HOLE NO.:	P-1	P-2	P-3	P-4	X-1	X-2	X-3
FOOTAGE:	676-677	751-752	731-732	672.6 - 673.6	978-979	607-608	438-439
	677-678	752-753	732-733	673.6 - 674.6	979-980	608-609	439-440
	678-679	753-754	733-734	674.6 - 675.4	980-981	609-610	440-441
	685-686	763-764	740-741	680.7 - 681.7	987-988	616-617	441-442
	686-687	764-765	741-742	681.7 - 682.7	988-989	617-618	442-443
	687-688	765-766	742-743	682.7 - 683.7	989-990	618-619	443-444
	697-698	772-773	752-753	692.6 - 693.6	996-997	625-626	450-451
	698-699	773-774	753-754	693.6 - 694.6	997-998	626-627	451-452
	699-700	774-775	754-755	694.6 - 695.6	998-999	627-628	452-453
	706-707	781-782	761-762	701.6 - 702.6	1005-1006	637-638	459-460
	707-708	782-783	762-763	702.6 - 703.6	1006-1007	638-639	460-461
	708-709	783-784	763-764	703.6 - 704.6	1007-1008	639-640	461-462
	715-716	793-794	770-771	710.5 - 711.5	1014-1015	646-647	471-472
	716-717	794-795	771-772	711.5 - 712.5	1015-1016	647-648	472-473
	717-718	795-796	772-773	712.5 - 713.5	1016-1017	648-649	473-474
	727-728	802-803	782-783	722.7 - 723.7	1023-1024	655-656	489-490
	728-729	803-804	783-784	723.7 - 724.7	1024-1025	656-657	490-491
	729-730	804-805	784-785	724.7 - 725.7	1025-1026	657-658	491-492
	736-737	811-812	791-792	731.7 - 732.7	1032-1033	667-668	498-499
	737-738	812-813	792-793	732.7 - 733.7	1033-1034	668-669	499-500
	738-739	813-814	793-794	733.7 - 734.8	1034-1035	669-670	500-501
	745-746	823-824	800-801	740.7 - 741.7	1041-1042	676-677	507-508
	746-747	824-825	801-802	741.7 - 742.7	1042-1043	677-678	508-509
	747-748	825-826	802-803	742.7 - 743.7	1043-1044	678-679	509-510
	757-758	832-833	812-813	752.7 - 753.7	1050-1051	685-686	513-514
	758-759	833-834	813-814	753.7 - 754.7	1051-1052	686-687	514-515
	759-760	834-835	814-815	754.7 - 755.7	1052-1053	687-688	515-516
	766-767	841-842	821-822	761.7 - 762.7	1059-1060	691-692	522-523
	767-768	842-843	822-823	762.7 - 763.7	1060-1061	692-693	523-524
	768-769	843-844	823-824	763.7 - 764.7	1061-1062	693-694	524-525
	775-776	853-854	830-831				
	776-777	854-855	831-832				
	777-778	855-856	832-833				
	787-788	862-863	842-843				
	788-789	863-864	843-844				
	789-790	864-865	844-845				
	796-797	871-872	851-852				
	797-798	872-873	852-853				
	798-799	873-874	853-854				
	805-806	883-884	860-861				
	806-807	884-885	861-862				
	807-808	885-886	862-863				
	817-818						
	818-819						
	819-820						

need thickness of mining zone for each borehole?

HOLE NO.:	X-4	X-5	X-6	X-9	X-10	X-11
FOOTAGE:	810-811	789-790	651-652	933-934	942-943	835-836
	811-812	790-791	652-653	934-935	943-944	836-837
	812-813	791-792	653-654	935-936	944-945	837-838
	819-820	798-799	663-664	942-943	954-955	847-848
	820-821	799-800	664-665	943-944	955-956	848-849
	821-822	800-801	665-666	944-945	956-957	849-850
	831-832	807-808	672-673	951-952	963-964	856-857
	832-833	808-809	673-674	952-953	964-965	857-858
	833-834	809-810	674-675	953-954	965-966	858-859
	840-841	819-820	681-682	963-964	972-973	865-866
	841-842	820-821	682-683	964-965	973-974	866-867
	842-843	821-822	683-684	965-966	974-975	867-868
	849-850	828-829	690-691	972-973	981-982	877-878
	850-851	829-830	691-692	973-974	982-983	878-879
	851-852	830-831	692-693	974-975	983-984	879-880
	861-862	837-838	702-703	981-982	993-994	886-887
	862-863	838-839	703-704	982-983	994-995	887-888
	863-864	839-840	704-705	983-984	995-996	888-889
	870-871	846-847	711-712	993-994	1002-1003	895-896
	871-872	847-848	712-713	994-995	1003-1004	896-897
	872-873	848-849	713-714	995-996	1004-1005	897-898
	879-880	855-856	720-721	1002-1003	1011-1012	907-908
	880-881	856-857	721-722	1003-1004	1012-1013	908-909
	881-882	857-858	722-723	1004-1005	1013-1014	909-910
	891-892	864-865	732-734	1011-1012	1023-1024	916-917
	892-893	865-866	734-735	1012-1013	1024-1025	917-918
	893-894	866-867	741-742	1013-1014	1025-1026	918-919
	900-901	873-874	742-743	1023-1024	1032-1033	925-926
	901-902	874-875	743-744	1024-1025	1033-1034	926-927
	902-903	875-876		1025-1026	1034-1035	927-928

4) Approximate location of the mining zone with the bore holes is located with respect to the Mahogany Marker location. The roof will be located on a natural parting plane 20 to 25 feet above the marker. The floor will also be located on a parting plane 35 to 40 feet below the marker. The final choice for a roof and floor location has not been made at this time.

5) The conformable contact between the Unita formation and the underlying Green River formation is usually undulatory and often not clearly defined. This is due to lithologic transitional changes. The Uinta formation consists mainly of sandstones and siltstones, whereas the Green River formation is basically shales and marlstones. The contact was picked from the Geologist's lithologic descriptions and by studying the geophysical logs, mainly the density, resistivity, caliper, natural gamma-ray logs and the density trace of the kerogen analysis log. The following contact locations were taken from the Geological Exploration Report.

P-1	199 Feet
P-2	370 "
P-3	265 "
P-4	180 "
X-1	470 "
X-2	104 "
X-3	-
X-4	299 "
X-5	324 "
X-6	185 "
X-9	413 "
X-10	396 "
X-11	335 "

WWM/vc
12/12/75

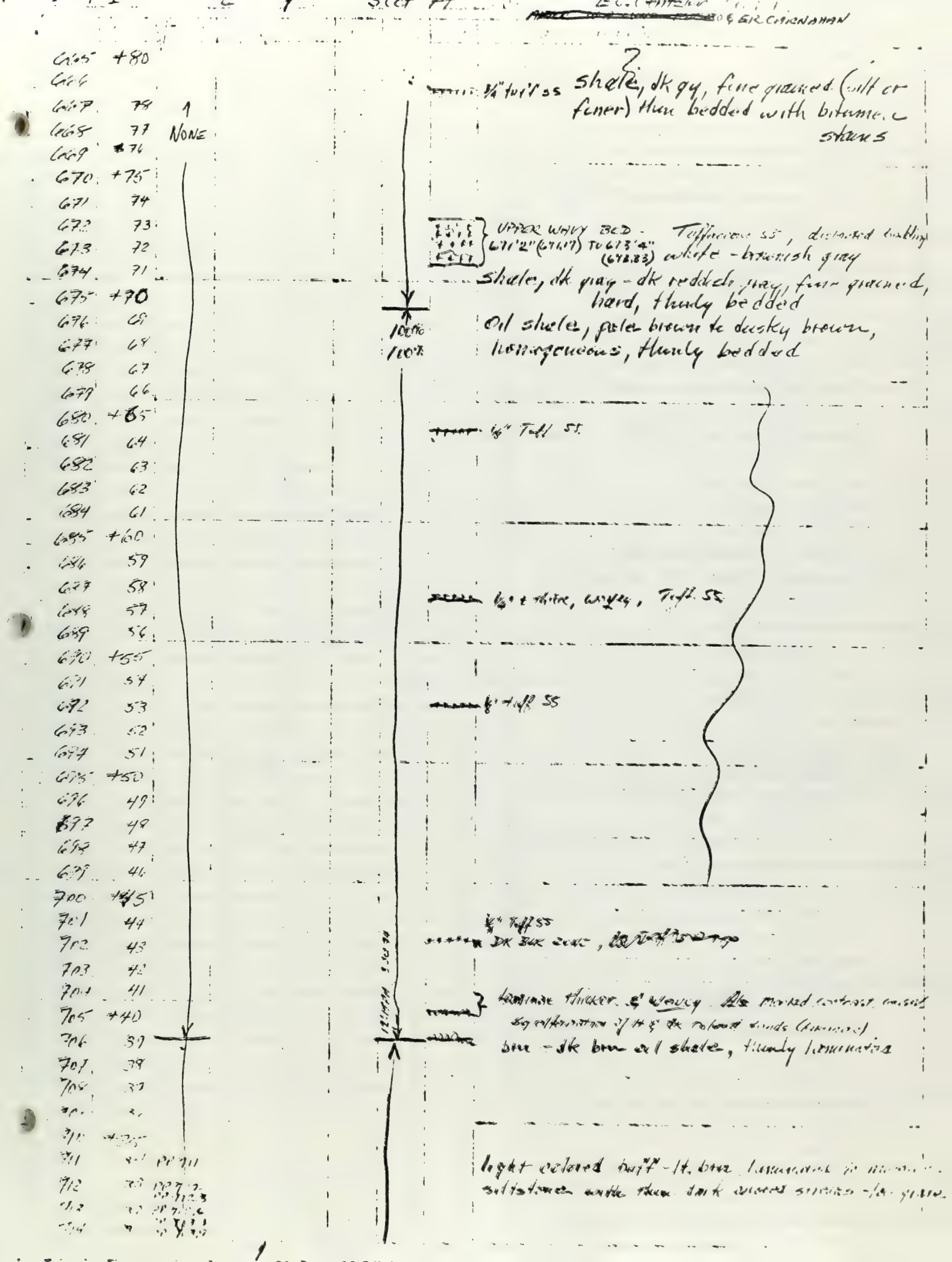
P.1 (cont)

1 / 7 Date 3 Oct 74 ... E.C. GLITZER ...

AFTER W.R. LUNDE ESQ.

615'	+130	None			100%	Oil Shale – Gray to dk Gray, silty calc, hard v. thinly-bedded. Boiling well developed. One thin beds of dk material; hard, non-calc. v. f grad to silt.
616	129				100%	
617	128					
618	127					
619	126					
620	+125					Black, Strong Sulfur odor
621	124					
622	123					Argillaceous Limestone – shaly, lt.-dk gray
623	122					
624	121					
625'	+120					
626	119					
627	118					
628	117					Shale, gy-dk gy, hard, calc, silty, silty,
629	116					
630	+115'					Shale, sandy, dk gray-dk reddish gray, lams thinly bedded
631	114					
632	113					
633	112					Shale as above with thin stringers of coarser material grading to fine sand
634	111					
635'	+110					
636	109					Shale, gy-dk gy, silty, hard-thinly bdd.
637	108					
638	107					
639	106					
640	+105					SS, fr fine-coarse?
641	104					
642	103					Shale, silty, dk gray with some coarser grained material
643	102					
644	101					
645'	+100	None			100	Shale, dk gray, mostly silty with black blebs of odd-formed material occurring in thin sandstone lenses
646	99				100	
647	98					
648	97					
649	96					
650	+95					
651	94					
652	93					
653	92					
654	91					
655'	+90					
656	89					
657	88					
658	87					
659	86					
660	+85					
661	84					
662	83					
663	82					

Form 9-330-1 (Rev. 1-70) (West-Texas)


Shale, dk gy, fine grained (silt or finer) thin bedded with bitume. stains
UPPER WAVY BED - 671'2" (671.17) TO 673'4" (672.83) Tuffaceous ss, dolomitic cemented white - brownish gray
Shale, dk gray - dk reddish gray, fine grained, hard, thinly bedded
Oil shale, pale brown to dusky brown, homogeneous, thinly bedded
NONE
100%
100%
1/4" Tuff ss
1/2" white, wavy, Tuff ss
1/4" Tuff ss
1/4" Tuff ss
Dk Brn shale, dolomitic
laminae thicker & wavy
Dk brn - dk brn oil shale, thinly laminated
light colored tuff - lt. brn laminae in

DATE _____ COLLAR ELEV. _____ TD _____ SHEET ___ OF ___ LOGGED BY _____

DEPTH	RELATIVE	FRAX	PP	ASSAY 10 20 30 40	CALCITE	LITH.	DESCRIPTION
715	+ 30						
716	29						
717	28						
718	27						
719	26						
720	+25						not been thinly laminated shale,
721	24						medium grade
722	23						
723	22						
724	21						
725	+20						light - dark brown, wavy, laminated,
726	19						good grade
727	18						light brown laminated shale with
728	17		728.6				interbedded laminated mudstone and
729	16						siltstone
730	+15						
731	14						brown - dark brown shale, good
732	13						grade
733	12						
734	11						
735	+10						(irregular break at 735.4 tuff layer,
736	9						mostly medium brown shale with
737	8						variegated very dark brown layers
738	7						
739	6						
740	+5						
741	4						
742	3						
743	2						
744	+1						
745	0		745.5				(irregular breaks - MAINLY AT 745.5
746	-1		746.8				each to each layer of tuff/ash ss, to small tuff layer)
747	-2						
748	-3		748.8				(irregular break at thin tuff layer)
749	-4						
750	-5						
751	6						
752	7						
753	8						
754	9						
755	-10		755.4				(irregular break at 755.4 tuff/ash layer)
756	11						
757	12						
758	-13						
759	14						
760	-15						
761	16						
762	17						
763	18						
764	19						

COMMENTS: Core was pulled at 754 ft after approx 4 ft was cut - jammed in barrel

CO. _____ DATE _____ COLLAR ELEV. _____ TD _____ SHEET ___ OF ___ LOGGED BY _____

DEPTH	REL TO MN	FRAX	PP	ASSAY 10 20 30 40	GAL/TON	BITH.	CLAY	DESCRIPTION
								"OIL SHALE"

DATE _____ COLLAR ELEV. _____ TO _____ SHEET ___ OF ___ LOGGED BY _____

DEPTH	REL TO MS	FRAX	PP	ASSAY 10 20 30 40	CAL/TON	DESCRIPTION
E15	- 11					
E16						11' blue low grade shale
E17						
E18						
E19						
E20	-15					
E21						light tan low grade limestone (silty)
E22						
E23						
E24						
E25						
E26						2' contorted sandy tuffaceous* (E26.7 to E28.7 + incl. breaks)
E27	-E2					
E28		70°				light tan low grade limestone
E29						
E30						
E31						
E32						
E33						
E34						
E35						
E36						
E37						
E38						
E39						
E40						
E41						
E42						
E43						
E44						
E45						med grade brn cl shale
E46						.2' tr placers ss
E47						low to med grade shale
E48						med grade shale
E49						
E50	-50.5					
E51	51.4					
E52	52.2					
E53	53					
E54						
E55	-55					
E56	56					
E57	57					
E58	58					
E59						
E60	60	70°				
E61						
E62						
E63						
E64						

NOTES:

* [illegible] bedding [illegible] small displacement deformation; contains a few [illegible]

DATE _____ COLLAR ELEV. _____ TD _____ SHEET ___ OF ___ LOGGED BY _____

DEPTH	RELIQUM	FRAX	PP	ASSAY 10 20 30 40	CALCITE	BTM	LITH	DESCRIPTION

DATE _____ COLLAR ELEV. _____ TD _____ SHEET _____ OF _____ LOGGED BY _____

DEPTH	REL TO MM	FRAX	PP	ASSAY 10 20 30 40	CAL/FOOT	LITH.	DESCRIPTION
915			915.6				
916							
917							
918							
919							
920	-1½		920.3				
921							
922							
923							
924							
925	-1½						
926							
927							
928							
929							
930	-1½						
931							
932			932.1				
933							
934							
935	-1½						
936							
937							
938							
939							
940	-1½						

COMMENTS:

CLEVELAND CLIFFS IRON CO. PROJECT: Hollis-Knox Joint Venture

HOLE NO: P-2 (ORE) SHEET 1 OF ___ DATE: 21 Oct 74 LOGGED BY: E.C. Gentzler COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	CAL/TON	REC. & RQD	LITH.	DESCRIPTION
573								
574								
575								
576								DRILLING CONTRACTOR:
577								ROGER SCHECKE, HENDERSON COLO
								DRILLING RIG:
								FAILING 2500, 12¾" CASING,
								6¾" CHRISTIANSEN "M-21" (5) DIAM. BIT
								DRILLER:
								JOHNNY GUSTAFSON
								ELEVATION DATUM:
								KELLY BUSHING (25'8" ABOVE M.S.L.)
								[XX] LAST CORE ZONE
								[++] TUFFACEOUS S
								[≡] BITUMEN FLECKS
								[≡] Nahcolite (XL aggregate - green.)
								[+] Hematitic blebs, streaks, laminae
								N.B. - The Mahogany Bed was shown @ 577 on the W.S.U. 88 density log of P-2 (Rig). The MHM was then projected 13' above this (as @ P-1 & Wasco EX-1) but this proved to be erroneous. MM logged @ 825.11 - 835.48. (819.11 - 819.48)
577		45°@.2				63%		(ORE)
578	+245	Vert Fx (25% Oil)						SHALE, med-dk brn; f.-thly laminated, V. Calc., appears to be "R-8" grade oil.
579		77° @ 66						
580								
581								
582								
583								(?)
584								TUFF SS* (584.05 - 584.19) & (584.25 - 584.44)
585								*"relict" texture. Hard, but core eroded (Sp.) in these zones. V. Highly Calc.
586								
587								
588								
589	+240							
590								
591								
592								TUFF SS (589.21 - 589.53), irreg. upper & lower contact, 1% porosity, 5% bit. fracs.
593								
594	+235							
595								(The chunks or pieces of core recovered between 589.53 and 594.00 are all the same Oil Shale - but the surfaces have the same Blue-gy color that the oil shale horizons display in vertical outcrops.)
596								One minor exception will be noted in one of these pieces).
597								
598								
599	+230							
600								
601								
602								

COMMENTS: CORE FROM INTERVAL 589.53 (MM — 605.8') WAS LEFT IN HOLE. (OTHER CORE IN SMALL BOXES & FRAMED CORNER OF SEC. 558 ft. DRILLED. USED TO BE RETRIEVED.) USED TO BE NOT THIN FRACTURE NOTES TO BE RETRIEVED.

THE CLEVELAND CLIFFS IRON CO. PROJECT: WHITE RIVER SHAFT EXPLORATION

HOLE NO: P-2 (CORE) SHEET 2 OF ___ DATE: 21 OCT. 74 LOGGED BY: EC GENTZLER COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
598	+225							
599								
596	+220							
597								
598								
599								
600								
601	+215							
602								
603								
604	+210							
605								
606								
607	+205							
608								
609								
610	+200							
611								
612								
613	+195							
614								
615								
616	+190							
617								
618								
619	+185							
620								
621								
622	+180							
623								
624								
625								

+++ = TUFF

××× = NAHCOLITE

= BITUMEN FLECKS & STRINGERS

= HIGH GRADE ZONE

[OIL SH] (See description preceding page)

Tuff. SS (612.30–612.37) A pebbly tuffaceous, highly irreg lower contact (Lead Core) ... (Tuff. stringers @ 612.10 & 612.80 (W3.5)

[OIL SH W/ TUFF] - fine to thinly laminated, marl-clay DK Brn low to med. grade, w/ many v. thin Tuff SS layers (Gradational) contact @ about 618 w/ OIL SH dominant

V. Calc. Interval 624.5–634 also contains many v. thin layers of Nahcolite & aggregates & irreg. ... Bitumen lense-like lets. Interval 634–637 appears to be high grade OIL SH & exhibits SHY dilatental cracks

Tuff SS (627.83–627.34): petrolif., dk SH laminations upper surface, lower surface, and rest discontinuous (rel. soft & non-calc)

Tuff. SS (629.48–629.60), f-vcrl, petrolif. irreg upper & lower contacts & Dark SH inclusions. Bedding in SH. only. SHY & dk stks above & below this zone. Tuff. rel. soft & non-calc.

NOTE (5) 8:10 PM, 22 OCT 74 — 29.64' CUT / 12.20 — 30.18' 14:30 AM, 22 OCT 74 — FILLED

Tuff SS (638.8–639) V. f-grnd., extremely SHY in OIL & bleeding gas, Zone actually consists of several Tuff. SS lenses, V irreg & wtr interbedded w/ the SH.

Tuff SS (645.28–.83), f-grnd, w/ many dk wl MI & some nahcolite

(Massive Nahcolite (?) 645.6 – 645.9 ... Analysis

COMMENTS: CORE LEFT IN THE HOLE & TAGGED FOR ADDITIONAL DATA IF REQUIRED. SEE DRILLING LOG FOR DETAILS. THE CORES LENGTH (31.41) OF THIS INTERVAL RESULT OF CONTINUING TO DRILL IN MEASUREMENT FROM DRILLING FLUID & CONTINUING GAS STICK-UP IN KELLY (TAKEN FROM TOTAL EXPOSED KELLY MINUS KELLY BUSHING HEIGHT)

AM 22 OCT 74 - REMEASURED ENTIRE LENGTH FULL SIZE PIECES INTACT

THE CLEVELAND-CLIFFS IRON CO. PROJECT: [illegible]

HOLE NO: F-2 (CORE) SHEET 3 OF ___ DATE: 22 Oct 74 LOGGED BY: EC GENTZLER COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
640	+175							(Lisa Silyield zone 640-650)
641							++++	Tuff SS lenses (651.80-.85), petrolif. limestone nod.
642								
643	[illegible]					90% / 99% REC		
644								
645	+170						++++	(Thin layer of Nahcolite ngg. @ 655.05)
646							++++	
647	[illegible]							
648								
649							++++	
650	+165							
651								
652	[illegible]					1:20 PM, 22 Oct 74 30.58' CUT / 30.15' REC		
653								(Many Bitumen flecks & veinlets)
654								(Med grade Oil zone 663-664)
655	+160						++++	
656								
657	[illegible]							
658							++++	
659								
660	+155					670.92		No CORE (670.49-670.92) & (671.21-671.2
661								
662	[illegible]						++++++	(Extremely High grade Oil zone (671-67
663								Containing thin (01-02) Tuff SS. (682
664		850.82						mod-coarse gnd w/ Nahcolite,
665	+150						++++	Tuff SS (675.8), Varies from .01-.10' thick
666		Vert Frx 676-29.70	.29 .22					med-gnd, w/ Nahcolite. Very wvy Contacts
667	[illegible]	677.6	.69			NOTE: (4)		& Cuts bedding in shale
668								(High Grade Zone [678.5 to 679.8]
669								
670	+145							
671								
672	[illegible]					30.49' Rec, 98% RQD		
673								
674								(High Grade Zone [684.8-685.8])
675	+140							
676								← Tuff SS (686.0-686.2), f-med-gnd, scattered dk
677	[illegible]					30.15' CUT / 30.49' REC, 99% REC		dead oil; extremely wvy-lens is intrabedd
678								w/ Sh.
679								
680	+135							
681								
682	[illegible]							
683								Tuff SS (693.42-.97), m-coarse gnd, w/ nahcol
684								& Sand w/ Alas. at Thick zone @ 694.2
685	+130		.61			8:30 AM, 23 Oct 74		& 695.05 & wvy contacts on last 2.
686								
687	[illegible]							(High Oil Zone 697.6 - top 699.0)
688								
689								

HOLE NO: P-2 (CORE) SHEET 4 OF ___ DATE: 23 Oct. 74 LOGGED BY: E.C. GENTZLER COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	CAL/TON	REC. & RQD	LITH.	DESCRIPTION
695	+125		.07			701.07		
696								
697								
698								(High Grade Zone)
699	+120							
700								(707.48-.45)
701	+115							Tuff Ss (707.68-.47) & (705.12-.24); mod-grn, distorted bedding, petrolitferous.
702		•	.80					
703								
704	+115		.96					Tuff Ss (709.80 - 710.56) much dead oil, [illegible] thin, bedded, slightly distorted, small inclusion at 710.40 (bark)
705								
706	+110					30.10' CUT / 30.10' REC / 99% REC & RQD		
707								Tuff Ss (713.28 - 713.58), [illegible], no oil,
708								
709	+110							Tuff Ss (716.32 - 716.44) petrol., distorted bdg
710								
711	+105		.24					Tuff Ss (718.05 - 718.29), V. Contorted bedding w/ Sh interbeds. Ss [illegible], & petrolif.
712								
713								Likewise for (719.10 - .15) & (719.30 - .32) &
714	+105							loss @ 721.3
715								
716								
717	+100					23 Oct 74 — 3:55 PM — NOTE (5)		
718								
719								(726.30 - 726.49)
720	+100							Tuff Ss (727.71 - 728.05), distorted bedding w/ Sh. interbeds, slightly petrolif. Bed @ (726.4 - 726.65) contains [illegible] (?).
721								
722								
723								
724	+95							
725						725.23		
726								Tuff Ss (731.27 - 731.32) & (731.50 - .55) highly [illegible] w/ pp & Sh Contacts, Petrolifferous.
727								
728								Tuff Ss (734.2 - .27) neg. Contacts, petrolif.
729	+90					141 1/2 REC / 101% RQD		
730			.30					Tuff Ss (734.30 - .45), neg upp Contact, highly [illegible] lower contact, Saturated w/ dead oil & [illegible] (?) & much Clay.
731	+42		.71					
732								
733								
734	+85							
735								
736								
737			.24					
738								
739	+80					12:45 PM 24 Oct 74 — 30.60 Ft / 30.29 Rec		Tuff Ss (742.81 - .95) & (743.21 - .51) very [illegible] Clay & petrolif
740								
741								UPPER WAVY BED - Tuff Ss (743.65 - 743.84) w/ wavy Sh laps (743.8 - .9) & [illegible]
742								
743								

COMMENTS:

THE CLEVELAND CLIFFS IRON CO. PROJECT: [illegible]

HOLE NO: P-2 (Core) SHEET 5 OF ___ DATE: 24 Oct. 74 LOGGED BY: EC Gentiles COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
744	+75							
745								
746								
747								
748								
749	+70							
750								
751								(Zone 751-760 contains numerous thin layers & isolated blebs of Hematite.)
752								
753								
754	+65					76.2%		(Appears to be 1' [illegible] zone to 767.8?)
755								
756								
757								
758								(Hematite layer [illegible] @ 754.45', BLK)
759	+60							1/4" [illegible] traces at some [illegible] 765.15' & 765.35' & 1.0' to 1.02' thick.
760								
761			.82					
762								(765-774 ; Cill(c) stemming Xing w/ shiny
763								
764	+55							
765								
766								
767								
768								
769								
770	+50							
771								
772			.91					
773								
774								
775	+45							(2 small, white, Chalcedony vert. [illegible] @ 781.3)
776								(V. High grade zone @ 781.85-782.2)
777								
778								Tuff ss, [illegible] (783.43-44) w/ Clay & silty pebbles, & V. pebbly beds
779								@ 781.7 [illegible] V. pebbly
780	+40							beds 783.74-.77,
781								(Medium grade = 784 = 783.6 to 785.7 Contains
782		4% (VISIBLE)						white & silty clastical Cherty)
783			.22					(Chloritic SH @ 782.2')
784	+35					78.4%		[illegible] (789.22 = 784.01), V. fine
785								to Fine Grained, V. to Silty, Calcite V. [illegible]
786	+30							to thin (incl) Vuggy zone filled w/ [illegible],
787								White Powdery-Mineral. Many [illegible] laminae
788			.12					[illegible] ss layers 782-784.
789			.33					
790	+30							(784.01-784.83) Grayish white, fine
791								w/ an X Carbonidal Mineral. HRT.
792	+21		.84					
793			.36					

NOTE (cont.) 784.83 to 789.22 — 80% rec. 1 ft. 3" reel

HOLE NO: P2 (CORE) SHEET 6 OF ___ DATE: 25 Oct 74 LOGGED BY: E.C. GENTZLER COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
	+25							
								(Mod Graphic Zone (802.4 – 803.7) chaotic bedding w/ thin petrolif. tuff ss.
	+20		.20				H	Tuff Ss (805.00 – 805.35) irreg contacts, V. Contorted bedding & Petrolif. Many fx
			.52					
						98% REC		([805.35 – 806.52] Zone of Heavily Fractured Tuff. Ss layers, lenses, & blebs)
			.96					Tuff Ss, Contorted, Extremely Petrolif (bleeding Oil) w clay & calcite
	+15		.41					
			.86					(.19' No Core)
			.01 .30 .43			1210A NSW, 25 Oct 74 30.63' CUT / 30.44 REC		HIGH GRADE OIL SH (812.86 – 814.4) V. Oil grade w/ several thin, tuff ss layers w/ Oil impregnates – all oil saturated – MB.??
	+10		.11					SHALE (815 – 820), lt. gry to med gy, waxy fracturing, calc & dolo
			.71					
	+5							
	0		.19					MAHOGANY MARKER (825.11 – 825.48)
								Tuff. Ss interbedded w SH.
								(One Jet rich dark colored layer of petrolifera. (828.5) Zone of thin layers & lenses of Petrol.)
	-5		.05			31.12 CUT / 30.18 REC 96 RQD		
			.73					
	-10							
			.30					Base, Extremely RICH Oil SH (839.30 – 839.68)
	-15		.81					MAHOGANY BED Ext. extrem. rich Oil SH (844.32 – 843.22) which has porthy flame Contact w/ MASSIVE NAHCOLITE Zone (842 – 843.02) which include V. highly distorted layers of extremely rich Oil SH.
		mostly filmy	20 e .22 20 e .02					
			.19 .54					
	-20		.14					
			.70					

Note: (E) 8:35 PM, 25 Oct 74

COMMENTS: (E) LOGGED & NIGHT BY HAND HEADLIGHTS

THE CLEVELAND CLIFFS IRON CO. PROJECT: [illegible]

HOLE NO: P-2 (CORE) SHEET 7 OF ___ DATE: 25 Oct 74 LOGGED BY: EC GENTZLER COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
844	-25							
845								
846								
847								
848			.80					(High grade Zone (853.75-.80))
849	-30							Tuff Sx (854.34-.57) Locally contorted, much taconite & slty Py interbedded w Sx.
850								
851								(High grade Zone (854.80-857.75)) w/ w/ a Py stringer @ (855.65-.67), MTRG w/ taconite XL aggregate (oil saturated) also 5' Below. Smaller stringer @ 855.76, & numerous others to 858.
852								
853								
854	-35		.84					
855								Oil SH & MUDSTONE (860.0-862.3) Light to dk brn, w/ variable Oil Cont = Contains distinctive zones of oil to dk brn, to blk SLTY intrg throughout & containing stringers thin tuff Sx & hematite. & occ. Nodular layers.
856								
857								
858								
859	-45							
860								
861								
862								
863			.36 .33					
864	-50							
865								
866			.49					
867								
868								
869	-55							
870								
871								
872								
873								
874	-60	Contact w/ altered Oil SH						
875								LOST CORE
876								
877		.25	.149 .76 .221					Oil SH - V. high grade Sx (874.15), & (874.25-.32)
878	-65	.25 .80	.127 .449 .86					
879			.85 .48					"Oil SH" Med, dk Brn, med. grade Slty Calc & Sly Siltstone & occ Sandy.
880			.71					
881			.102 .21					
882		.54 Vert. .11 N	.034 .84 .771 .90					
883	-70	Oil SH	.005 .17 .13					Tuff Sx - oil sat.
884			.84					
885								
886								
887								
888	-75		.72					(ext. High Grade bed (888.72-.76))
889								
890			.30 .78 .147					
891								
892								
893		.159	.87					

COMMENTS: Up & beginning of shift - 50 / ordered NEW CORE Cutter: P-2 (CORE) By HARRISON, Cut 0.52' of 3.19' left in hole on previous run recorded.

3:00 PM, 26 Oct 74 — 30.26' Cut / 27.07' Rec / 89% Rec — ETG

12:30 PM, 26 Oct 74 — ETG

4:00 PM, 26 Oct 74 — 28.79' Cut / 30.22' Rec / 102% Rec — ETG

HOLE NO: P-2 (CORE) SHEET 8 OF ___ DATE: 26 Oct 74 LOGGED BY: EC GENTILE COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
877	-80							
885								Chalcedony (?) (908.74-.74), V. wavy lay, v.
894								massive, opaque, white.
897								
903								Tuff SS lenses, V. distorted bedding, Minor oil & some Oil
907	-85							
910								(Beds thicker & Stly distorted)
901								(Bleeding Oil from Tuff SS @ (908.03-07))
902			###					(Hem, Py, manganese layers & lenses)
903		Faint bleeding Oil						
904	-90							
905			.20					
906			.68					
907			.55 .52					Tuff SS (101') @ (913.58) bleeding minor Oil.
908	-95		.34 .76					
909			.34 .77					
910			.80					
911								
912			.37 .88					
913	-100							Tuff SS (919.92-920.10). Thin layers interbedded
914								w/ thin layers Sh, petrolif. Some layers bleeding O.
915								do @ 920.35-90)
916								
917								
918	-105							Tuff SS (924.45 ±) bleeding Oil & containing
919								several thin Chalcedonic layers
920								
921								
922			.56					(Thin tuff SS (as above) bleeding Oil
923	-110							
924			.32					Tuff SS (930.70-.95) bleeding Most Oil & gas, 3 thin
925								Such layers between 930.46 & 930.70.
926								
927								MARLSTONE, lt to med Hard- gray, V. Calc,
928	-115							(935.95 - 936.6)
929								
930			.47					SILTSTONE & THIN SS LAMINAE OF (936.4-939.
931		44 @ .05 .13	.92 .09 .83					Bleeding Oil & gas profusely from Thin layers (
932								Some 1/4 to 1/2" thick)
933								
934	-120	Heavy bleeding Oil						SILTSTONE & MARLSTONE, Hard to Med
935								
936			.83					
937			.53					
938								
939	-125							
940			.22					
941		52	52 .98 .85					
942		Int.						
943		731						

-30.01 CUT / 29.99' REC
100 ### REC
11 PM, 27 Oct 74
ECG

THE CLEVELAND CLIFFS IRON CO. PROJECT: [illegible]

HOLE NO: F-2 (core) SHEET 9 OF ___ DATE: 27 Oct 74 LOGGED BY: E.C. GENTZLER COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
949	-130		.07					
950			.40					
951								
952			.98					
953			.25, .45, .73					
954	-135							
955								
956								Tuff Ss (958.00 - 958.17), highly Carbonated, w/ Slt interbeds & Oilsmite(?) or Bitumin Carbonated beds
957								
958								
959	-140					30.7' CUT / 30.22 REC 98% REC		
960								(Some distortion of bedding)
961								
962								
963								
964								
965	-145					7:00 PM, 27 Oct 74 — ECG		
966								Tuff Ss (966.80 - .94) w/ much Oilsmite(?)
967								do (967.60 - .72) w/ more Oil layers
968		Healed Vert.						Oilsmite(?) layer (968.80 - .94)
969								Tuff Ss (969.55 - .70) w/ Oilsmite(?) layer @ bot
970	-150							
971								
972								
973						968		Tuff Ss (973.00 - .16), Oil Soak, many gas
974								
975	-155							LOST CORE
976								Tic Sh (976.38 - 980.7) Mod grade, distorted bedding (upper part (esp. 977.85 - .95))
977								
978								Containing thin, wkly Carbonated layers & blebs @ 978.12, 5' layer w. Vert. frac (978.00 - .10)
979		Vert .02 - .10						
980	-160							
981								
982								
983								(more shumpage in calc @ 982.7)
984			.58			31.70 CUT / 29.85 REC 94% REC		
985	-165		.46, .13, .78					Tuff Ss (982.62 - .78) Carbonated, petrolif layer
986								
987			.66, .09					(Highly veined, fairly bedded)
988			.67					
989								
990	-170							(Oil)
991			.65					
992								(Oilsmite(?) layer - 992.50 - .52)
993			.56					Tuff Ss (992.88 - 993.12), Dk, highly Carbonated
994			.66					(minor shumpage in bedding @ 993.00)
995	-175							
996								(It has to smell Bad)
997						2:15, 29 Oct 74 — ECG		Calcitized bedding & Low grade Oil Sat
998								Tuff Ss (998.88 - 999.12), Carbonated, petrolif
999		Vert	.52					

COMMENTS:

THE CLEVELAND-CLIFFS IRON CO. PROJECT: Little Rock Area Contract 0126

HOLE NO: P-2 (CORE) SHEET 10 OF ___ DATE: 24 Oct 74 LOGGED BY: E.C. Gentzler COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH	DESCRIPTION
894	-180							
896								
898								(low to mod grade)
900			.34.37					Tuff ss (1002.95-1003.2), as above w/ thin (<1")
902			.38.41					lam. of
904			.25					buff, olive ash (?) layer below.
906	085		.51			99%		
908			.54					
910			.91					(Mgsm, f. laminy, calc)
912			.62					
914			.177					
916								
918								(mod grade core; disturbed bedding)
920	-170							
922			.72					
924			.71					
926								
928								
930								(O-tuffaceous) ~~zone 1005-1007~~ (1015.07-.10)
932	085							
934			.20					
936								
938								
940								
942			.09					(mod grade; highly disturbed bedding)
944	-260							
946								
948			.20					
950		X-SECTION Healed vert.						Tuff ss (1024.05-.10), bleeding ash, cont-
952			.11					inuing lower & start of Sherman ss (1051.50)
954	-105							w/ healed vert. frx. (See X-section) in FRX Co.
956								
958			.62					(Mod-high grade [1023.75-1024.55] &
960								[1024.60-1025.25])
962			.10					
964	210							
966								
968			.17					
970			.35					
972			.142					
974								1028.5 - 1031.0 = 2.76' NO CORE
976	-075							
978								
980								
982								
984								
986	230							
988								
990								
992								
994								
996	075 -225							

NOTES: Topsoil and loose rock fill.

HOLE NO: P3 (cont) SHEET 1 OF ___ DATE: 24 Oct 74 LOGGED BY: E.C. Gentzler COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. % RQD	LITH.	DESCRIPTION DATUM = Ground Level
								DRILLING CONTRACTOR:
								LAYNE WESTERN, DENVER, CO
								RIG:
								FOREMOST 2500, 12 3/4 CASING
								6 3/4" CHRISTIANSEN "MC-2C" DIAM. BIT
								DRILLERS:
								JOHN SIEGERS - TOOL PUSHER
								JACK TABOR - NIGHT TOUR
574						574.4	XXXXX	JIM KAVA - DAYS - NOON
								METHOD:
								AIR MIST
								SERVICE COMPANY:
								WESTERN AIR, GRAND JUNCTION
								FRANK MACKENDRICK: OPER TOUR
								RAY HANCOCK: AIR HAND
								+++ Tuff. Ss.
								*** Nahcolite
								--- Bituminous Flecks
								High Grade Oil Sh
								Hem Hematite pseudomorphic after Nahcolite, lenses, & flecks
								Gilsonite flecks.
582	+215 to +210		32					OIL SHALE, med-dk Brn; V.F. laminated, micr to v.low grade, w. occ. Gilsonite. Oily sl/hy, mod Calc.
583								
584								
585	+210		.50					Tuff Ss layers - irreg up & low contacts, poorly sorted w much clay, pot vuggy
586			.30					
587			.25					
588			.72					
589								
590	+205	Vert 590.6-594				594.4		
591			.40					OIL SHALE med-dk brn - very finely laminated mat'l with a few interbeds & lenses of coarser clastics - med to good yield
592	+200 to +195		.01					
593								
594								
595	+200		.60					
596								
597								
598			.60					
599			.60					

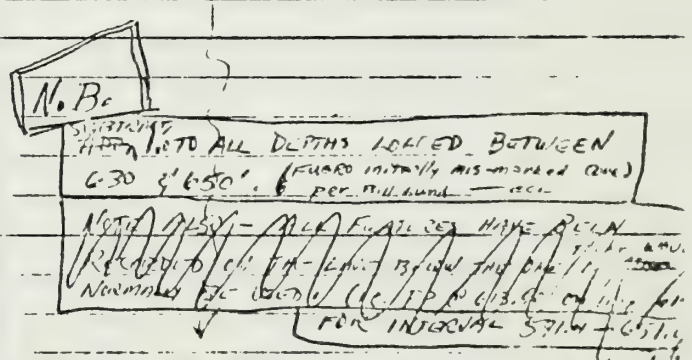
6.0 GPM, 24 Oct 74 — 30.0 Cut / 28.66 Rec / 89% RQD (Loss assigned to top where rubbly / Piece of core unmined)

COMMENTS:

THE CLEVELAND CLIFFS IRON CO. PROJECT: [illegible] / TRACT C-8

HOLE NO: P-3 (CORE) SHEET 2 OF ___ DATE: 24 Oct 74 LOGGED BY: ~~E.C. GENZLER~~ E.R. CHANAHAN COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
600	+195							
601			.30					
602	4230		.80					
603								
604			.60					
605	+190		.70			29.83' FH Run Rec 16' 24-25 MIDNITE 10/24		Oil Shale as above with numerous silty layers
606			.60					
607								
608								
609			.00					
610	+185		.60					
611								
612	+220		.50 .20 .60				====	distinct bit. band
613			613.60 .40					
614								
615	+180		.20 .10				====	distinct bit. band
616			.60 .30					
617			.90				+++++	very thin
618			.40					
619			.30					
620	+175		.30					partly sorted zone
621			.10			621.25		
622	4200		.20					OIL SHALE - med grade, silty with
623			.00 .40					thin zones of higher grade material -
624								scattered, very thin ss layers, finely laminated
625	+170		.70					
626			.80					OIL SHALE - med grade - uniform -
627	4205							finely laminated - very thin ss as above
628								
629			.40				+++++	
630	+165							
631								
632	4200							
633								
634			.90				+++++	
635	+160		[illegible]				+++++	
636			.20					
637	+155							
638								
639							+++++	
640	+155					28.79' Run - 29.70' Rec - Fell at bit at 5:45 AM - 2 hr trip		OIL SHALE as above but increased kerogen content in very localized zones - several thin to very thin ss layers
641							+++++	
642	4170							
643			.100					
644								
645	+150							
646			.20					
647							+++++	
648			.40					localized increase in kerogen content
649			.00				+++++	



THE CLEVELAND CLIFFS IRON CO. PROJECT:

HOLE NO: P-3 (CORE) SHEET 3 OF ___ DATE: 10/25/74 LOGGED BY: E.C. GENTZLER COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	CAL/TON	REC. & RQD	LITH.	DESCRIPTION
650	+145							OIL SHALE - med grade - with: Kerog ss
651								Lobs & stringers - many fine flecks of bit material
652	4450							
653								
654								
655	+140							
656								THIN layers & lenses of Kerog and Hematite & Py - also occurs as filling in ss
657								
658								Tuff ss, irreg lenses, petrolif & containing Py & Kerog
659			.58					(ppb .58 occurs in thin (ca .05') almost anhydritic Marlstone)
660	+135							
661								
662	4430							Zone of thin bentonite layers & ~~conglom~~ layers. Also thin flecks of Bitumen & Calcite)
663								
664								
665	+130							
666								
667								Tuff ss (667.62-.72) & (668.85-669.00) Highly irr contact, much clay, & V. petrolif. Silt distorted bedding below ea.
668								
669								
670	+125		.10					
671								
672	+1160							
673								
674								
675	+120							Tuff ss (675 676.32-676.12) & - Saturated w/ dead oil
676								
677								Tuff ss lenses (677.30-.40) & (677.70-.78) V. irreg, much clay, & petrolif
678								
679								
680	+115		.75					(Mod to High Oil Grade Zone)
681								
682	4430	Healed Vert (?)						
683								
684								
685	+110		.74					(Mod to High Oil Grade Zone)
686								
687								
688								
689			.75					Tuff ss (689.42-.63) V. irreg contacts,
690	+105							Saturated w/ dead oil
691								do ss (691.54-.75) & (691.80-692.42)
692	4430	Healed Vert						w/ some sh interbeds
693								
694								
695	+100	Healed Vert						
696								
697								Tuff ss (698.05-.15), as above w/ some sh
698			.75					
699		Healed Vert (?)	.86					do (699.60-700.80) w/ some sh interbeds

COMMENTS:

THE CLEVELAND CLIFFS IRON CO. PROJECT: Gill Ridge Mine Exploration

HOLE NO: P-3 (CORE) SHEET 4 OF ___ DATE: 25 OCT 74 LOGGED BY: E.C. GENTZLER & E.R. CANNAHAN COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	CAL/TON	REC. & RQD	LITH.	DESCRIPTION
700	+95							(Minor hematite bleb, ½" in some buff ss scam
701								SILTSTONE
702	±30							V. finely lam., med brn, ½" SILTSTONE & V. thin beds, ½"
703								SILTY to med. calc.
704								
705	+90							
706								Fractured
707		Heated Vein (3)				ECG		Buff ss. (707.23-.34) as above
708		do!						(708.90-709.04)
709			.08					
710	+85					711.04		
711			.00					OIL SHALE - brn to dk brn, thin bed
712	±20		.13					[illegible] some thin bed [illegible]
713			CORE LOSS .60					
714			.49					
715	+80							
716								Siltstone, med brn to lt brn -
717			.20					poor grade
718			.62					
719								
720	+75		.50					
721								
722	±							6" high grade zone - oil shale -
723			.30 .45					
724								
725	+70							
726			.85					
727			.70 .30					Siltstone as above
728			.50					
729								
730	+65							
731			.30					4" high grade zone oil shale
732								siltstone as above
733								
734								
735	+60		.10					
736			.10 .60					
737								
738			.30					
739			.90					
740	+55							
741			.00			741.16		OIL SHALE, med-dk br
742			.00 .10					
743		-15°						
744								Siltstone, buff colored, very fine gr.
745	+50		.50					narrow hi grade oil shale zone
746			.60					OIL SHALE - med with thin dk brn [illegible]
747			.80					
748								narrow hi grade oil shale zone
749								

CORE HOLE: P-3

Drilled 3 1/2" hole to 711.04 ft. Set 4" casing to 711.04 ft. Cemented with 15 sacks of cement. Started drilling 3 1/2" hole at 1:20 AM 10/26

Finished rdm at 12:15 PM 10/27

Started drilling 3 1/2" hole at 2:15 PM 10/27

Drilled 3 1/2" hole to 741.16 ft. Set 4" casing to 741.16 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 3:30 PM 10/27

Finished rdm at 11:30 AM 10/28

Drilled 3 1/2" hole to 768.50 ft. Set 4" casing to 768.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 12:30 PM 10/28

Finished rdm at 4:30 PM 10/28

Drilled 3 1/2" hole to 798.50 ft. Set 4" casing to 798.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 10/28

Finished rdm at 10:30 AM 10/29

Drilled 3 1/2" hole to 828.50 ft. Set 4" casing to 828.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 10/29

Finished rdm at 4:30 PM 10/29

Drilled 3 1/2" hole to 858.50 ft. Set 4" casing to 858.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 10/29

Finished rdm at 10:30 AM 10/30

Drilled 3 1/2" hole to 888.50 ft. Set 4" casing to 888.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 10/30

Finished rdm at 4:30 PM 10/30

Drilled 3 1/2" hole to 918.50 ft. Set 4" casing to 918.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 10/30

Finished rdm at 10:30 AM 10/31

Drilled 3 1/2" hole to 948.50 ft. Set 4" casing to 948.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 10/31

Finished rdm at 4:30 PM 10/31

Drilled 3 1/2" hole to 978.50 ft. Set 4" casing to 978.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 10/31

Finished rdm at 10:30 AM 11/1

Drilled 3 1/2" hole to 1008.50 ft. Set 4" casing to 1008.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 11/1

Finished rdm at 4:30 PM 11/1

Drilled 3 1/2" hole to 1038.50 ft. Set 4" casing to 1038.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 11/1

Finished rdm at 10:30 AM 11/2

Drilled 3 1/2" hole to 1068.50 ft. Set 4" casing to 1068.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 11/2

Finished rdm at 4:30 PM 11/2

Drilled 3 1/2" hole to 1098.50 ft. Set 4" casing to 1098.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 11/2

Finished rdm at 10:30 AM 11/3

Drilled 3 1/2" hole to 1128.50 ft. Set 4" casing to 1128.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 11/3

Finished rdm at 4:30 PM 11/3

Drilled 3 1/2" hole to 1158.50 ft. Set 4" casing to 1158.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 11/3

Finished rdm at 10:30 AM 11/4

Drilled 3 1/2" hole to 1188.50 ft. Set 4" casing to 1188.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 11/4

Finished rdm at 4:30 PM 11/4

Drilled 3 1/2" hole to 1218.50 ft. Set 4" casing to 1218.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 11/4

Finished rdm at 10:30 AM 11/5

Drilled 3 1/2" hole to 1248.50 ft. Set 4" casing to 1248.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 11/5

Finished rdm at 4:30 PM 11/5

Drilled 3 1/2" hole to 1278.50 ft. Set 4" casing to 1278.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 11/5

Finished rdm at 10:30 AM 11/6

Drilled 3 1/2" hole to 1308.50 ft. Set 4" casing to 1308.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 11/6

Finished rdm at 4:30 PM 11/6

Drilled 3 1/2" hole to 1338.50 ft. Set 4" casing to 1338.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 11/6

Finished rdm at 10:30 AM 11/7

Drilled 3 1/2" hole to 1368.50 ft. Set 4" casing to 1368.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 11/7

Finished rdm at 4:30 PM 11/7

Drilled 3 1/2" hole to 1398.50 ft. Set 4" casing to 1398.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 11/7

Finished rdm at 10:30 AM 11/8

Drilled 3 1/2" hole to 1428.50 ft. Set 4" casing to 1428.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 11/8

Finished rdm at 4:30 PM 11/8

Drilled 3 1/2" hole to 1458.50 ft. Set 4" casing to 1458.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 11/8

Finished rdm at 10:30 AM 11/9

Drilled 3 1/2" hole to 1488.50 ft. Set 4" casing to 1488.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 11/9

Finished rdm at 4:30 PM 11/9

Drilled 3 1/2" hole to 1518.50 ft. Set 4" casing to 1518.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 11/9

Finished rdm at 10:30 AM 11/10

Drilled 3 1/2" hole to 1548.50 ft. Set 4" casing to 1548.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 11/10

Finished rdm at 4:30 PM 11/10

Drilled 3 1/2" hole to 1578.50 ft. Set 4" casing to 1578.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 11/10

Finished rdm at 10:30 AM 11/11

Drilled 3 1/2" hole to 1608.50 ft. Set 4" casing to 1608.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 11/11

Finished rdm at 4:30 PM 11/11

Drilled 3 1/2" hole to 1638.50 ft. Set 4" casing to 1638.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 11/11

Finished rdm at 10:30 AM 11/12

Drilled 3 1/2" hole to 1668.50 ft. Set 4" casing to 1668.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 11/12

Finished rdm at 4:30 PM 11/12

Drilled 3 1/2" hole to 1698.50 ft. Set 4" casing to 1698.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 11/12

Finished rdm at 10:30 AM 11/13

Drilled 3 1/2" hole to 1728.50 ft. Set 4" casing to 1728.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 11/13

Finished rdm at 4:30 PM 11/13

Drilled 3 1/2" hole to 1758.50 ft. Set 4" casing to 1758.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 11/13

Finished rdm at 10:30 AM 11/14

Drilled 3 1/2" hole to 1788.50 ft. Set 4" casing to 1788.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 11/14

Finished rdm at 4:30 PM 11/14

Drilled 3 1/2" hole to 1818.50 ft. Set 4" casing to 1818.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 11/14

Finished rdm at 10:30 AM 11/15

Drilled 3 1/2" hole to 1848.50 ft. Set 4" casing to 1848.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 11/15

Finished rdm at 4:30 PM 11/15

Drilled 3 1/2" hole to 1878.50 ft. Set 4" casing to 1878.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 11/15

Finished rdm at 10:30 AM 11/16

Drilled 3 1/2" hole to 1908.50 ft. Set 4" casing to 1908.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 11/16

Finished rdm at 4:30 PM 11/16

Drilled 3 1/2" hole to 1938.50 ft. Set 4" casing to 1938.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 11/16

Finished rdm at 10:30 AM 11/17

Drilled 3 1/2" hole to 1968.50 ft. Set 4" casing to 1968.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 11/17

Finished rdm at 4:30 PM 11/17

Drilled 3 1/2" hole to 1998.50 ft. Set 4" casing to 1998.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 11/17

Finished rdm at 10:30 AM 11/18

Drilled 3 1/2" hole to 2028.50 ft. Set 4" casing to 2028.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 11/18

Finished rdm at 4:30 PM 11/18

Drilled 3 1/2" hole to 2058.50 ft. Set 4" casing to 2058.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 11/18

Finished rdm at 10:30 AM 11/19

Drilled 3 1/2" hole to 2088.50 ft. Set 4" casing to 2088.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 11/19

Finished rdm at 4:30 PM 11/19

Drilled 3 1/2" hole to 2118.50 ft. Set 4" casing to 2118.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 11/19

Finished rdm at 10:30 AM 11/20

Drilled 3 1/2" hole to 2148.50 ft. Set 4" casing to 2148.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 11/20

Finished rdm at 4:30 PM 11/20

Drilled 3 1/2" hole to 2178.50 ft. Set 4" casing to 2178.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 11/20

Finished rdm at 10:30 AM 11/21

Drilled 3 1/2" hole to 2208.50 ft. Set 4" casing to 2208.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 11/21

Finished rdm at 4:30 PM 11/21

Drilled 3 1/2" hole to 2238.50 ft. Set 4" casing to 2238.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 11/21

Finished rdm at 10:30 AM 11/22

Drilled 3 1/2" hole to 2268.50 ft. Set 4" casing to 2268.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 11/22

Finished rdm at 4:30 PM 11/22

Drilled 3 1/2" hole to 2298.50 ft. Set 4" casing to 2298.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 11/22

Finished rdm at 10:30 AM 11/23

Drilled 3 1/2" hole to 2328.50 ft. Set 4" casing to 2328.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 11/23

Finished rdm at 4:30 PM 11/23

Drilled 3 1/2" hole to 2358.50 ft. Set 4" casing to 2358.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 11/23

Finished rdm at 10:30 AM 11/24

Drilled 3 1/2" hole to 2388.50 ft. Set 4" casing to 2388.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 11/24

Finished rdm at 4:30 PM 11/24

Drilled 3 1/2" hole to 2418.50 ft. Set 4" casing to 2418.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 11/24

Finished rdm at 10:30 AM 11/25

Drilled 3 1/2" hole to 2448.50 ft. Set 4" casing to 2448.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 11/25

Finished rdm at 4:30 PM 11/25

Drilled 3 1/2" hole to 2478.50 ft. Set 4" casing to 2478.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 11/25

Finished rdm at 10:30 AM 11/26

Drilled 3 1/2" hole to 2508.50 ft. Set 4" casing to 2508.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 11/26

Finished rdm at 4:30 PM 11/26

Drilled 3 1/2" hole to 2538.50 ft. Set 4" casing to 2538.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 11/26

Finished rdm at 10:30 AM 11/27

Drilled 3 1/2" hole to 2568.50 ft. Set 4" casing to 2568.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 11/27

Finished rdm at 4:30 PM 11/27

Drilled 3 1/2" hole to 2598.50 ft. Set 4" casing to 2598.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 11/27

Finished rdm at 10:30 AM 11/28

Drilled 3 1/2" hole to 2628.50 ft. Set 4" casing to 2628.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 11/28

Finished rdm at 4:30 PM 11/28

Drilled 3 1/2" hole to 2658.50 ft. Set 4" casing to 2658.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 11/28

Finished rdm at 10:30 AM 11/29

Drilled 3 1/2" hole to 2688.50 ft. Set 4" casing to 2688.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 11/29

Finished rdm at 4:30 PM 11/29

Drilled 3 1/2" hole to 2718.50 ft. Set 4" casing to 2718.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 11/29

Finished rdm at 10:30 AM 11/30

Drilled 3 1/2" hole to 2748.50 ft. Set 4" casing to 2748.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 11/30

Finished rdm at 4:30 PM 11/30

Drilled 3 1/2" hole to 2778.50 ft. Set 4" casing to 2778.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 11/30

Finished rdm at 10:30 AM 12/1

Drilled 3 1/2" hole to 2808.50 ft. Set 4" casing to 2808.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 12/1

Finished rdm at 4:30 PM 12/1

Drilled 3 1/2" hole to 2838.50 ft. Set 4" casing to 2838.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 12/1

Finished rdm at 10:30 AM 12/2

Drilled 3 1/2" hole to 2868.50 ft. Set 4" casing to 2868.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 12/2

Finished rdm at 4:30 PM 12/2

Drilled 3 1/2" hole to 2898.50 ft. Set 4" casing to 2898.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 12/2

Finished rdm at 10:30 AM 12/3

Drilled 3 1/2" hole to 2928.50 ft. Set 4" casing to 2928.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 12/3

Finished rdm at 4:30 PM 12/3

Drilled 3 1/2" hole to 2958.50 ft. Set 4" casing to 2958.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 12/3

Finished rdm at 10:30 AM 12/4

Drilled 3 1/2" hole to 2988.50 ft. Set 4" casing to 2988.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 12/4

Finished rdm at 4:30 PM 12/4

Drilled 3 1/2" hole to 3018.50 ft. Set 4" casing to 3018.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 12/4

Finished rdm at 10:30 AM 12/5

Drilled 3 1/2" hole to 3048.50 ft. Set 4" casing to 3048.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 12/5

Finished rdm at 4:30 PM 12/5

Drilled 3 1/2" hole to 3078.50 ft. Set 4" casing to 3078.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 12/5

Finished rdm at 10:30 AM 12/6

Drilled 3 1/2" hole to 3108.50 ft. Set 4" casing to 3108.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 12/6

Finished rdm at 4:30 PM 12/6

Drilled 3 1/2" hole to 3138.50 ft. Set 4" casing to 3138.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 12/6

Finished rdm at 10:30 AM 12/7

Drilled 3 1/2" hole to 3168.50 ft. Set 4" casing to 3168.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 12/7

Finished rdm at 4:30 PM 12/7

Drilled 3 1/2" hole to 3198.50 ft. Set 4" casing to 3198.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 12/7

Finished rdm at 10:30 AM 12/8

Drilled 3 1/2" hole to 3228.50 ft. Set 4" casing to 3228.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 12/8

Finished rdm at 4:30 PM 12/8

Drilled 3 1/2" hole to 3258.50 ft. Set 4" casing to 3258.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 12/8

Finished rdm at 10:30 AM 12/9

Drilled 3 1/2" hole to 3288.50 ft. Set 4" casing to 3288.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 12/9

Finished rdm at 4:30 PM 12/9

Drilled 3 1/2" hole to 3318.50 ft. Set 4" casing to 3318.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 12/9

Finished rdm at 10:30 AM 12/10

Drilled 3 1/2" hole to 3348.50 ft. Set 4" casing to 3348.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 12/10

Finished rdm at 4:30 PM 12/10

Drilled 3 1/2" hole to 3378.50 ft. Set 4" casing to 3378.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 12/10

Finished rdm at 10:30 AM 12/11

Drilled 3 1/2" hole to 3408.50 ft. Set 4" casing to 3408.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 12/11

Finished rdm at 4:30 PM 12/11

Drilled 3 1/2" hole to 3438.50 ft. Set 4" casing to 3438.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 12/11

Finished rdm at 10:30 AM 12/12

Drilled 3 1/2" hole to 3468.50 ft. Set 4" casing to 3468.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 12/12

Finished rdm at 4:30 PM 12/12

Drilled 3 1/2" hole to 3498.50 ft. Set 4" casing to 3498.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 12/12

Finished rdm at 10:30 AM 12/13

Drilled 3 1/2" hole to 3528.50 ft. Set 4" casing to 3528.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 12/13

Finished rdm at 4:30 PM 12/13

Drilled 3 1/2" hole to 3558.50 ft. Set 4" casing to 3558.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 12/13

Finished rdm at 10:30 AM 12/14

Drilled 3 1/2" hole to 3588.50 ft. Set 4" casing to 3588.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 12/14

Finished rdm at 4:30 PM 12/14

Drilled 3 1/2" hole to 3618.50 ft. Set 4" casing to 3618.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 12/14

Finished rdm at 10:30 AM 12/15

Drilled 3 1/2" hole to 3648.50 ft. Set 4" casing to 3648.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 12/15

Finished rdm at 4:30 PM 12/15

Drilled 3 1/2" hole to 3678.50 ft. Set 4" casing to 3678.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 12/15

Finished rdm at 10:30 AM 12/16

Drilled 3 1/2" hole to 3708.50 ft. Set 4" casing to 3708.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 12/16

Finished rdm at 4:30 PM 12/16

Drilled 3 1/2" hole to 3738.50 ft. Set 4" casing to 3738.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 12/16

Finished rdm at 10:30 AM 12/17

Drilled 3 1/2" hole to 3768.50 ft. Set 4" casing to 3768.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 12/17

Finished rdm at 4:30 PM 12/17

Drilled 3 1/2" hole to 3798.50 ft. Set 4" casing to 3798.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 12/17

Finished rdm at 10:30 AM 12/18

Drilled 3 1/2" hole to 3828.50 ft. Set 4" casing to 3828.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 12/18

Finished rdm at 4:30 PM 12/18

Drilled 3 1/2" hole to 3858.50 ft. Set 4" casing to 3858.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 12/18

Finished rdm at 10:30 AM 12/19

Drilled 3 1/2" hole to 3888.50 ft. Set 4" casing to 3888.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 12/19

Finished rdm at 4:30 PM 12/19

Drilled 3 1/2" hole to 3918.50 ft. Set 4" casing to 3918.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 12/19

Finished rdm at 10:30 AM 12/20

Drilled 3 1/2" hole to 3948.50 ft. Set 4" casing to 3948.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 12/20

Finished rdm at 4:30 PM 12/20

Drilled 3 1/2" hole to 3978.50 ft. Set 4" casing to 3978.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 12/20

Finished rdm at 10:30 AM 12/21

Drilled 3 1/2" hole to 4008.50 ft. Set 4" casing to 4008.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 12/21

Finished rdm at 4:30 PM 12/21

Drilled 3 1/2" hole to 4038.50 ft. Set 4" casing to 4038.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 12/21

Finished rdm at 10:30 AM 12/22

Drilled 3 1/2" hole to 4068.50 ft. Set 4" casing to 4068.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 12/22

Finished rdm at 4:30 PM 12/22

Drilled 3 1/2" hole to 4098.50 ft. Set 4" casing to 4098.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 12/22

Finished rdm at 10:30 AM 12/23

Drilled 3 1/2" hole to 4128.50 ft. Set 4" casing to 4128.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 12/23

Finished rdm at 4:30 PM 12/23

Drilled 3 1/2" hole to 4158.50 ft. Set 4" casing to 4158.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 12/23

Finished rdm at 10:30 AM 12/24

Drilled 3 1/2" hole to 4188.50 ft. Set 4" casing to 4188.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 12/24

Finished rdm at 4:30 PM 12/24

Drilled 3 1/2" hole to 4218.50 ft. Set 4" casing to 4218.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 12/24

Finished rdm at 10:30 AM 12/25

Drilled 3 1/2" hole to 4248.50 ft. Set 4" casing to 4248.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 12/25

Finished rdm at 4:30 PM 12/25

Drilled 3 1/2" hole to 4278.50 ft. Set 4" casing to 4278.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 12/25

Finished rdm at 10:30 AM 12/26

Drilled 3 1/2" hole to 4308.50 ft. Set 4" casing to 4308.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 12/26

Finished rdm at 4:30 PM 12/26

Drilled 3 1/2" hole to 4338.50 ft. Set 4" casing to 4338.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 12/26

Finished rdm at 10:30 AM 12/27

Drilled 3 1/2" hole to 4368.50 ft. Set 4" casing to 4368.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 12/27

Finished rdm at 4:30 PM 12/27

Drilled 3 1/2" hole to 4398.50 ft. Set 4" casing to 4398.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 12/27

Finished rdm at 10:30 AM 12/28

Drilled 3 1/2" hole to 4428.50 ft. Set 4" casing to 4428.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 12/28

Finished rdm at 4:30 PM 12/28

Drilled 3 1/2" hole to 4458.50 ft. Set 4" casing to 4458.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 12/28

Finished rdm at 10:30 AM 12/29

Drilled 3 1/2" hole to 4488.50 ft. Set 4" casing to 4488.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 12/29

Finished rdm at 4:30 PM 12/29

Drilled 3 1/2" hole to 4518.50 ft. Set 4" casing to 4518.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 12/29

Finished rdm at 10:30 AM 12/30

Drilled 3 1/2" hole to 4548.50 ft. Set 4" casing to 4548.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 12/30

Finished rdm at 4:30 PM 12/30

Drilled 3 1/2" hole to 4578.50 ft. Set 4" casing to 4578.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 12/30

Finished rdm at 10:30 AM 12/31

Drilled 3 1/2" hole to 4608.50 ft. Set 4" casing to 4608.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 12/31

Finished rdm at 4:30 PM 12/31

Drilled 3 1/2" hole to 4638.50 ft. Set 4" casing to 4638.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 12/31

Finished rdm at 10:30 AM 1/1

Drilled 3 1/2" hole to 4668.50 ft. Set 4" casing to 4668.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 1/1

Finished rdm at 4:30 PM 1/1

Drilled 3 1/2" hole to 4698.50 ft. Set 4" casing to 4698.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 1/1

Finished rdm at 10:30 AM 1/2

Drilled 3 1/2" hole to 4728.50 ft. Set 4" casing to 4728.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 1/2

Finished rdm at 4:30 PM 1/2

Drilled 3 1/2" hole to 4758.50 ft. Set 4" casing to 4758.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 1/2

Finished rdm at 10:30 AM 1/3

Drilled 3 1/2" hole to 4788.50 ft. Set 4" casing to 4788.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 1/3

Finished rdm at 4:30 PM 1/3

Drilled 3 1/2" hole to 4818.50 ft. Set 4" casing to 4818.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 1/3

Finished rdm at 10:30 AM 1/4

Drilled 3 1/2" hole to 4848.50 ft. Set 4" casing to 4848.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 1/4

Finished rdm at 4:30 PM 1/4

Drilled 3 1/2" hole to 4878.50 ft. Set 4" casing to 4878.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 1/4

Finished rdm at 10:30 AM 1/5

Drilled 3 1/2" hole to 4908.50 ft. Set 4" casing to 4908.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 1/5

Finished rdm at 4:30 PM 1/5

Drilled 3 1/2" hole to 4938.50 ft. Set 4" casing to 4938.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 5:30 PM 1/5

Finished rdm at 10:30 AM 1/6

Drilled 3 1/2" hole to 4968.50 ft. Set 4" casing to 4968.50 ft. Cemented with 15 sacks of cement.

Started drilling 3 1/2" hole at 11:30 AM 1/6

Finished rdm at 4:30 PM 1/6

Drilled 3 1/2" hole to 4998.50 ft. Set 4" casing to 4998.50 ft. Cemented with 15 sac

CO: CLEVELAND CLIFFS IRON CO. PROJECT: [illegible]

HOLE NO: P-3 (COREY) SHEET 5 OF ___ DATE: 10/26/14 LOGGED BY: E.L.C. & E.C. COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	CAL/TON	REC. & RQD	LITH.	DESCRIPTION
750	+45							OIL SHALE, DK BRN
751								OIL SHALE, MED BRN with scattered thin
752								~~beds of~~ finely laminated dk. brn.
753			.80					bands.
754								
755	+40		.60					
756			.50					
757								tuff - intermittent ~~lenses~~ nucleations
758								& thin stringers
759			.40 .60					
760	+35		.50					H. Grade Oil Shale in concentrated thin bands
761								OIL SHALE, MED BR, silty
762	~~+30~~		.10 .40					
763			~~.50~~					~~SILTSTONE~~, buff to light gray (~~Tuff~~ = ~~Ash~~,
764			.10 .40					with a few thin, light brn
765	+30		.50					interbedded shale zones. - ~~Tuff~~ is
766			.60					finely laminated with slightly contorted bedding
767			.20 .50 .90					at 765.5 & 767.4 ~~interbedded~~
768			.50					OIL SHALE, finely laminated, med
769			.20					brn to gray - decreasing kerogen content
770	+25		.10					Siltstone, light gray
771			.48					
772	~~+20~~							
773			.28					
774								
775	+20							
776								OIL SHALE, dark br - blk, finely lam, slightly
777			.58					bedding
778			.12					(Hard, dense, ~~5~~ dolomitic)
[illegible]			.24					
780	+15		.05 .60					OIL SHALE, brn, hard, thinly bedded
781			.50 .12					Tuff SS, contorted bdd, ~~5~~ containing dark
782	~~+10~~	Vert. fract.	.43					& much clay.
783			.64	← along 10.01 CAST surface				
784								
785	+10							
786			~~.3~~					
787								
788								
789								
790	+5							
791								
792	~~+0~~							
793								
794								(Tuff ~~SS~~ grades into dolo. thin tone w. kerogen thin laminations)
795	0	Vert fract healed						Tuff SS Bx (795.60 - 796.05), rock clay, some dolo.
796			.36					[MAHOGANY MARKER]
797								
798			.15	2 along fract surface				
799			.18 .30					

3:10 PM, 26 OCT 14 — 30.00' CUT / 30.00' REC — ECG

7:52 AM 10/27/14 — 2.00' CUT / 2.00' REC

10.01' CUT / 10.01' REC

E. CLEVELAND CLIFFS IRON CO. PROJECT: Empire Mine, Silver Bay, Minn. Area

HOLE NO: P3 (core) SHEET 6 OF ___ DATE: 26 Oct 74 LOGGED BY: EC GENTZLER COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
800	-5		.42					
801			.04			801.04		
802								
803			.34					
804			.14					
805	-10		.33					
806								High grade dk. sh. (807.32-.42)
807			.32					
808								do (808.16-.88) w/ [illegible]
809								(distorted bedding)
810	-15							
811								
812			.9					High grade dk banded zone 811.6 to 812.9
813								812.4-813.05 - contorted tuff
814								
815	-20					30.2% Cut / 28.6% Rec		
816								
817								
818								
819								MAHOGANY FE BED (?)
820	-25		.43					Extremely high grade zone (sh - [illegible] content)
821								Core Loss
822								
823								
824								
825	-30							
826								
827								
828								
829								
830	-35					831.04		Siltstone, buff colr. Handle bar bands
831								Siltstone, buff to blue (to 839)
832								
833								
834								
835	-40							
836			~ .10					
837								
838								
839								
840	-45		.35					Siltstone: - silty slate, lt blue to buff
841			.00					with few narrow bands of darker
842			.10					colored slate to 852
843								
844								
845	-50							
846			.30					
847			.10					
848								
849								

H.C. CLEVELAND CLIFFS IRON CO. PROJECT: Little River Mine Exploration, GA, US

HOLE NO: P3 (cont) SHEET 7 OF ___ DATE: 27 Oct 74 LOGGED BY: E.R. CANAHAN COLLAR: ___ TD: ___
E.C. GENTZLER

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
850	-55		.20					
851			.80					
852			.20 .40					Siltstone, buff to tan, banded to 852
853			.20 .60					
854			.10 .20					rubble zone 852.40 - 852.85 (core loss)
855	-60		.10 .45					
856			.15					
857			.60					
858								
859			.10					Tuff ss 856.2 to 856.55 = irreg break at base
860	-65		.70					SILTY SHALE, med brn to gray
861			.100					grading to tan siltstone
862			.65					at 860
863								
864			.20					Siltstone, tan, laminated
865	-70		.30					" with narrow bands of dk brn shale
866			.20					
867			.100					
868			.90					
869		/15°	.00					Hi Grade Shale Zone, dk brn-blk
			.80					Siltstone, banded, tan-grey
			.20 .15					
			.20 .35					
870	-75		.10					Cesar Drilling 8:45 AM EST 10/27
871			.40					
872			.50					870.05 to 870.90 fossiliferous ss - mottled lt. tan brn disturbed bedding - unconf. U & L Contacts - irreg bioturb
873			.50					
874								Med grade oil shale
875	-80		.15					banded shale
876			.60					
877			.50					Siltstone, tan to gray, banded
878								to ~~877~~ 856.6
879			.40					
880	-85							30.05 CUT, 29.83 RECOV.
881			.70					
882			.00					
883								
884			.50					
885	-90		.60 .95					Tuff ss, bleeding oil
886			.00					SILTSTONE, tan-gray, finely laminated, hard
887			.50					(calc. to dolomitic)
888								~~Tan Siltstone~~
889			.30					
890	-95		.13 .20					
891			.95			891.04		(oil Saturated zone)
892								
893								
894								
895	-100		.96					
896			.06					(Bleeding oil from upper bomb)
897			.39 .08					Mudstone, lighter gray, hard
898								
899			.84					

43' left on bottom & recovered on following run, etc.

HOLE NO: P3 (CODE) SHEET 8 OF ___ DATE: 27 Oct 74 LOGGED BY: E.C. GENTZLER COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	CAL/TON	REC. & RQD	LITH.	DESCRIPTION
900	-105		.31					
901								(Becoming lt to med Brn)
902			.87					Marlstone
903								
904								
905	-110							
906			.00					
907			.65					
908								
909			.25					
910	-115							
911								
912								Marlstone
913								
914			.16 .69					OIL SHALE
915	-120							
916								
917								
918			.45					(saddling thinner & silty disturbed)
919								SILTSTONE, tan-gray, finely laminated tuff ss / laminated
920	-125							" " "
921			.00					
922			.50					
923								laminated tuff ss
924			.40					
925	-130							
926			.30					
927			(tbl.) .00					very dk oily looking silt-stone
928								
929								
930	-135		.90					SILTSTONE, A.A.
931								
932			.00					
933								
934								
935	-140		.30					laminated tuff ss
936			.30 .50 .45					
937								
938								
939								SILT STONE A A
940	-145		.50					
941			.55					
942								
943			.10					tuff ss 943.0-943.2 gray
944			~.2					
945	-150							
946			.80					
947			.70					
948								
949			~.5					tuff ss, Needles 1.1F

HOLE NO: F-3 SHEET 9 OF ___ DATE: 10/26/74 LOGGED BY: EKC COLLAR: ___ TD: ___

(1" CORE)

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	CAL/TON	REC. & RQD	LITH.	DESCRIPTION
950			10 .30 .50			950.19		950-955 variegated shale, lt & dk tan
951			.30			STARTED DRILLING 10/25 AM		bands — minor bed distortion at 950 94-b
952			.20 .50					
953			00 .70 .85					
954			05.30 10.50					
955			(.00 .95)					7 pps, 4.24' core loss between 955.00 & 955.95
956			(.15 .77)					4 pps. between 956.15 & 956.77
957			.30					955-964.0 banded gray clay stone - ~~3~~
958			.90					~~beds dist. slumping & silt~~ conglomerate
959			.40 .60				FEET	— 2 thin zones of tuffass
960			.00 .20					
961			.75					
962			.50					
963			.25 .75					
964		— 15°	.70					bed dist slumping at diff angles
965			.25					964-978 banded gray clay stone
966			.40 .25					
967			.55					
968			10 .50 32 .60					
969			.25					
970			10 .70					
971			.25					
972			.90				++++	tar impregnated zone (blue day) 972.34 - 972.40
973			.50 .90					
974			.40 .90					
975								distorted beds — slumping
976			.10 .50 .80					
977			.00 .25 .80					
978			.20 .50 .90					978 - 980 gray siltstone
979			.20 .45 .55					
980			.30 .40			980.16		gray siltstone, very fine + grades
981			.50					to clay stone — very fine. Have
982			.00 .20 30 .40 .75					light & dark bands — moderately uneven
983			55.43.90					bedding planes are common — diff colorations
984			.20 .70					
985			.00 .30 .60 .90					
986			.40 .90					Same as above. but generally silter
987			.20 .50					more massive zones between bedding pla.
988			.00 .35 .90					
989			.70					
990			.10 .40 .60					
991								
992			.20 .65					
993			.70					
994			.30					
995	-20°		.20					
996								
997			no rec →					997-998, 5 pps. 4.2' drilled core 1.5' core loss assigned
998		—	.40					finely laminated fine siltstone, gray
999			.30					

STARTED DRILLING 10/25 AM

CAL #1971 Recv. 24.48'

STARTED DRILLING 6:15 AM 10/27

Core Run 1 21.2' 1 Ko-Cell

THE CLEVELAND CLIFFS IRON CO. PROJECT: [illegible]

HOLE NO: P-3 (CORE) SHEET 10 OF ___ DATE: 28 OCT 74 LOGGED BY: E.R. GANNAHAN / E.C. GANTZLER COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	CAL/TON	REC. & RQD	LITH.	DESCRIPTION
1000	-205		30 .90					
1001			.70					
1002			.40 .10					
1003			.50					
1004			40 .60					SHALE, Brn, silty
1005	-210		.10					
1006			.30					
1007			.50 .90					Silt stone gray - lt brn - buff, finely laminated
1008			.40					
1009			35 .55					3 pcs from 1008.55 to 1010.0, all core less assays
1010	-215					1010.0		
1011			.08 .77 .37					
1012								Clay St (1012.34-.55), Hard, Grade to Siltstone (1012.55 -), Bed, Brn, Chem.
1013			.35 .47					
1014			.42					
1015	-220		.41					
1016			.21 .34 .55					Taconite (1016.28-.80), Silicified dol (Hard)
1017			.25 .60 .73 .68	.52 .35 .27				ds (1016.80-1017.20)
1018			.35					
1019			.10 .45					(Clay Band)
1020	-225		.71					
1021			.58					
1022			.18 .31	.51				(Hard) Taconite (1022.18-1023.45)
1023								No Core
1024			.37 .42					
1025	-230		.10 .67					Clay (1" Brn)
1026								
1027			.13					
1028			.00 .14 .72					
1029			.33					
1030	-235		.11 .91					
1031			.73					
1032			.42					
1033								
1034			.62					
1035	-240		.03					
1036			.08					
1037			.35 .20					
1038								Taconite (1038.36-.60) Intermediate, Gran Red & Buff Clay, Mod Hard
1039								
1040	-245		.57 .53					
1041								Clay - Lt Brn - Soft - Mod Calc, Thin, Lam (Limonite)
1042			.70					
1043								
1044			.64 .21					
1045	-250							
1046			.69					
1047								
1048								
1049								

HOLE NO: P-3 (Core) SHEET 11 OF ___ DATE: 28 Oct 74 LOGGED BY: EC Gentzler COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	CAL/MON	REC. & RQD	LITH.	DESCRIPTION
1050	-255							
1051								
1052								
1053								Fissile zone (1053.7ft - 1054.80), Dull A, thin bedded, highly calc., fine grained, fissility oil from several oil stands between 1053.8'-1054' (Minor slumpage in bedding @ 1054')
1054								
1055	-260							
1056			.18					
1057			.81					
1058								
1059			.85					OIL SHALE, med-dk gry, finely laminated, scattered pyritic XTALS of ~~pyrite~~ & thin inclusions of dk gry calc. sulfides occurrence is obviously influenced by lenticular nature of the sediment (to 1064)
1060	-265							
1061								
1062			.77					
1063								
1064								(2 ft to 1061 Brn med. calc)
1065	-270		.71 .81					
1066								
1067			.25 .33	.33 .42				
1068								
1069			.16					
1070	-275							(Marcasite-limonite filling)
1071								
1072								
1073								
1074								
1075	-280							(Marcasite fill layer c. 01° thick)
1076								
1077								
1078								
1079								
1080	-285							
1081			.65 .79					Limestone (1081.68-.78), lt gry, v.f.gnd
1082								
1083			.23 .02 .33 .08					(Lithic-Shumpage (1082.32-.39)
1084			.12 .58 .62					(1084.12-.15) as above, w/ minor soft clay substance (as above)
1085	-290							
1086								
1087			.74					
1088								
1089								
1090	-295		.44					
1091								
1092								
1093								
1094								Minor fracturing & thin bedding
1095	-300							(1094.82-1095.2) Sy-dk gry, v. fgnd w/ thin calcareous
1096								
1097								
1098								
1099								

COMMENTS:

THE CLEVELAND CLIFFS IRON CO. PROJECT: Sonnet Area Test Holes

HOLE NO: P-4 SHEET 1 OF ___ DATE: 10/24/74 LOGGED BY: ERC. COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
								Drill Contractor: Layne-Western Co-D 200
								Drillers: Cox, Kauzlarich
								Helpers: Mardiosian, S.gnorelli
390	(+250)							Siltstone with bitumen blebs
391								
392								
393								
394								
395	+245							
396								
397								
398								
399								
400	+240							
401								
402								
403								
404								
405	+235							
406								
407								
408								
409								
410			409.9					1' tuff layer
411								dk brn med to high grade oil shale
412			411.6					thin tuffaceous ss layer w calcite
413		60°						med to low grade laminated, silty shale
414			413.6					thin tuffaceous ss layer w calcite
415	+225							med-low grade laminated silty shale
416								
417			416.9					very break - very thin lnr carbonaceous material
418			417.6					" " clay small blebs (tuff?)
419								silty shale - mostly low grade to med grade streaks
420	+220							
421								
422								
423		90°						
424								slight bedding disturbance
425	+215							silty shale - mostly low grade w carbonaceous strks
426								
427								
428								
429								
430								
431		PP						thinly Silty Shale - low grade laminated oil shale
432		432.35						with carbonaceous (bitumen) flecks
433								moderately calcareous (calcium)
434								(.01' tuff at 433.55)

THE CLEVELAND CLIFFS IRON CO. PROJECT

HOLE NO: P-4 (CORE) SHEET 2 OF ___ DATE: 24 Oct. 74 LOGGED BY: ___ COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
435	~~4255~~							Silty Shale (cont')
436		436.1M						
437		437.8						437.8 - 438.6 Sandy Siltstone with small carbonate grds
438								438.6 - 440.7 slightly higher Carbonaceous content - darker bands
439	~~4380~~	439.7(M?)						
440		440.72						440.72 → 0.02' tuff. ss (dark color - may contain chl by XRD although magnetic (noted with magnet
441		441.45						441.45 → 0.03' tuff. ss ("
442		442.7						
443								
444								444.05 → 0.05' tuff ss ("
445	~~4295~~	445.75						
446								
447								
448		448.83						
449		449.36						
450	~~4490~~	450.3						
451								Silty SHALE (CONT') - Red generally as above
452								451.5 - 451.8 - Sandy Siltstone with small calcium nodules
453	+250		453.3					452.3 - 453.5 higher hydrocarbon content
454								
455	~~460~~		455.05					~~459~~
456								
457								457.1 - 458.1 - Sandy Siltstone with small calcium nodules & less hydrocarbons
458			458.15					
459								458.1 - 458.7 - clay seams - ball clay
460								458.7 - 462.6 - darker colored - higher hydrocarbon content
461								
462			462.6					462.6 - 463.0 - high hydrocarbon content
463	+240							
464								464.5 → 0.05' of dark ss (tuff?) probable hydrocarbon content
465								
466								
467			467.9					
468			~~455.15~~					
469								
470								Silty SHALE (CONT') low grade thinly laminated oil shale as above, with bitumen & less, slightly calc rocks
471								
472								472.1 - 475.18 - increased hydrocarbon content throughout w/ more abundant dark laminations of bitumen thins
473	+230							
474								474.2 thin (0.05') bed of tuff ss with hydrocarbon stringers of higher hydrocarbon
475								
476								
477								475.2 - 482.58 continued silty shale, thinly laminated with moderate amount of hydrocarbons
478			478.17					
479								
480								increasing losses in interval
481								
482			482.8					482.58 → .82 tuff. ss with bitumen
483	+220							482.82 to 483.6 same as
484								

CORE LOSS:

WERE OFF BY 1 FOOT & ADJUSTED DEPTHS WERE USED ON THIS RUN. PIPING PLUGGED & ARE THEREFORE IN ERROR (NOTED LOSSES ADJUSTED)

OTHER BREAKS IN CORE LOSS MECHANICAL

DUE TO DRILLER'S DISCREPANCY - BEGINNING STRING AT END OF RUN - HAD TO REMEASURE OUT FROM HERE ON - ALL DEPTHS

HOLE NO: P-1 SHEET 3 OF ___ DATE: 10/24/74 LOGGED BY: _____ COLLAR: ___ TD: ___

DEPTH	±MM (CORE)	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
485								483.6–487.14 leaner section of hydrocarbons, occasional bitumen flecks
486								
487								
488								Mostly med to low grade silty shale - very hard - conchoidal fracture -
489			.20					
490								conchoidal than high grade zones -
491			.100 .95					thinly laminated - consistent
492								texture & grain size -
493	110							very thin
494								
495								
496								
497								
498								
499								
500								Similar to above but overall grade
501			.60					appears to be less – less high grade zone
502								
503								plast flag
504								
505			.20					very thin but 55 – zero of cockiness
506			.10					slightly transverse w/ tt contacts – irreg break @ 1"
507								
508								OIL SHALE – uniform dk brn – fine
509								grained, silty – consistent texture &
510								color
511								
512								
513			~ .60					
514								
515			~ .50					
516								
517			~ .50					OIL SHALE as above but interspersed
518			.70					with numerous thin to very thin, slightly
519			.70					contorted ss seams
520								
521								1/2 ss - irreg w&t bndries - oily
522			.50					
523			.60					
524								
525			.70					
526			.30					
527								
528								OIL SHALE (still somewhat silty) with
529								numerous very thin ss (tuff?) seams
530								throughout. Small clay flecks (<1 mm)
531								noted throughout section. Beds appear to
532								be increasing. Moderately calcareous.
533								Thin (<0.01') & tuff ss seams – thinner ones
534								also present in section

EXC

FRAC

FRAC

COMMENTS:

THE CLEVELAND-CLIFFS IRON CO. PROJECT: Eagle Rock Oil Shale (Tomas Hanna)

HOLE NO: P-4 Core SHEET 4 OF ___ DATE: 10/25/74 LOGGED BY: ___ COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
535								Same as above (Oil Shale)
536			536.1					
537								≈ tuff ss seams (<0.05')
538								538.25 grade of hydrocarbons drops off below this depth to 542.2
539								
540								542.2 to 543 - higher grade zone
541			541.74					
542								0.1' tuff ss
543			(ss) 543.68					543.68 (0.02' of ss)
544								
545								less hydrocarbon material throughout shale still finely laminated with
546								occasional sand seams & clay flecks which become less abundant below 545.6
547								
548			(ss) 548.5					Oil Shale (similar to above) still has occasional ss seams & clay flecks - both decrease in number by 550.0
549								
550								
551								
552								still finely laminated
553								
554			554.1					
555								higher grade oil shale (apparent 1.4')
556								
557								
558								
559								
560			560.7					560.7 - 561.5 higher grade oil shale
561								
562								
563								
564								
565								
566								
567								Oil Shale (basically silty shale)
568								568.5 finely laminated
569								568.4 higher grade
570			570.7					569.4 to 575.2 - fairly uniform grade oil shale
571								
572								
573			573.85					
574								
575								high grade (dark color) oil shale
576			576.25					576.1
577								0.1' tuff ss
578								576.1 to bottom of run fairly uniform medium grade oil shale
579								
580			580.6					
581								582.0 (thin tuff ss)
582								
583			583.6					583.6 - 583.8 tuff ss
584								

OTHER BREAKS IN CORE ARE USUALLY MARKED MB - Meaning Mechanical Break

COMMENTS:

HOLE NO: F-4 Core SHEET 5 OF ___ DATE: 10/25 & 26/74 LOGGED BY: ___ COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
585								Oil Shale (as above)
586								
587						587.05		OIL SHALE, med grade, unlam.
588								1' tuff zone
589								
590			.80					OIL SHALE, as above, slightly silty
591								
592								
593			.40					
594								
595								
596			.90					
597			.70					
598								
599			.10					tuff - 598.3 - 599.7 break at 599.5 (internal)
600								tuff - break at base
601								plant fibers noted
602								OIL tuff zone 602.8 - 603.5
603								
604								OIL SHALE, med to low grade (subtle change
605								slight increase in silt/ash
606								
607						607.00		OIL SHALE, lt brn, low grade, v. v. silty
608			.90					tuff 608.2 - 608.7, oil saturated
609								thin tuff, oily
610			.30					OIL SHALE as above with considerable
611			irreg .40					uniformity thruout the run - thin zones of
612			.80					tuffaceous ss appear irregularly (these
613								stringers to discontinuous blebs - slightly undulatory
614			.50					contacts)
615								
616			.00					616.00 - 616.30 oily tuff
617			.80					617.4 - 617.8 tuff
618								Silty shale, lt brn - low grade
619								thin tuff
620								
621			.10					thin tuff
622								
623								
624								
625			.60					1' tuff - internal break
626								
627								Oil Shale - thinly laminated, lt to
628								medium grade, oil shale, with
629			.10					occasional higher grade zones
630								Occasional tuff to dominant
631			.85					most prominent are noted (interbedded
632								
633								
634								634.25' tuff ss - thin interbedded

COMMENTS:

THE CLEVELAND-CLIFFS IRON CO. PROJECT: Oil Shale (Tarts Area)

HOLE NO: P-4 CORE SHEET 6 OF ___ DATE: 10/26 & 27/14 LOGGED BY: _____ COLLAR: _____ TD: _____

DEPTH (FT)	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
635			~635.0					634.8 to 637.7 – tuff. SS, highly distorted, easily recognizable, feeds hydrocarbons in gaseous patches or zones. Besides distorted bedding there is a mixture of beds of various sand/silt ratios.
636			≈ .6					
637			≈ .45					637.7 WAVY tuff BED
638			.0					
639			(50) .28					639.28 tuff ss (odor) (.03')
640								
641			.29			RQD = 100		
642								
643	160		.37			12:45 PM 10/26/14 Barrel Full		Fairly uniform low to medium(?) grade oil shale from bottom of tuff (637.7) to end of run – occasional SS seams (very thin)
644			.9					
645			.26					
646			645.8			C-165		
647						5:25 PM 10/26/14		OIL SHALE (as above) – finely laminated, low to medium grade (except where noted)
648								
649								
650						started coring		Very few SS seams now
651								
652								
653	150					cut		– 653.6 to 660.1 med grade oil Shale
654								
655								
656								
657								
658								
659						14.93 recovered / 99% RQD = 100		Higher grade material (659.3 to 660.1)
660								
661								
662								
663			663.5			7:50 PM stopped coring		thin light colored shale immediately above a thin SS seam
664								664.5 to 666.7 higher grade zone with enriched zone from 665.6 to 666.7
665								
666						666.5		
667								Oil Shale – brn with thin very dk brn bands to 669.5 – clayey sm at pp
668			.05					
669			.00					
670						10:40 PM 10/26/14		669.5 to 674.1 banded Slt/stone – buff to lt brn, thin clayey sms at parting places – minor distortion of bedding at 673.8 & 675.8 – small rugs at 674.1 – some recirculated laminations at 674.7
671			.70					
672			.60					
673	120		~.80					
674								
675			~.80			15.75 ft cut, 20.25 ft recv'd (some from previously cored interval) (Core Barrel Length = 40 ft)		Brn silty shale, very uniform to 684
676			.20					
677			.70					
678								
679								
680								
681								
682								
683			.10					
684			.10 .10					

THE CLEVELAND CLIFFS IRON CO. PROJECT: E. Part of Section 16

HOLE NO: P-4 CCI SHEET 7 OF ___ DATE: 10/24/74 LOGGED BY: FLC COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
685								PP darker colored shale
686								685' to 686.9 - shale, med brn with several thin discontinuous blebs & seams of tuff ss
687			.80					1+in banded (lt-dk) silty shale (687-694)
688								similar bedded tuff zones
689			.30					
690								2.5' tuff zone
691			~.40					.2' tuff zone
692			.70 .55					
693	+10		.54					
694			~.50 ~.90					break within notted irreg tuff zone break within bedded irreg. tuff zone
695			~.90					" " " " " "
696								694.5 - 702.60 gray to lt. brn silty shale
697								
698			.20					
699			.25					
700								
701			.80					
702	0		~.70					
703			~.70					MAHOGANY MARKER 703.60 - 703.80 (given mid-point, from U & L contacts - stair-step break near the top)
704			.30					
705			~.50					703.05 to end of run - lt brn to gray finely laminated shale
706								
707			.70					707.3 - tuff ss - bleeding hydrocarbons
708								Oil Shale - finely laminated, low to med. grade
709			.40					
710			.50					
711			711.40					3 PP's occur along very thin clay seams
712			.20 .80					
713			.70					
714								
715			.80					716.42 to end of short run is very rich, light weight core (PROBABLY top of MAHOGANY BED)
716			.50					716.72 - Break in core / rided core probable loss of core
717			717.4					Very Rich Oil Shale, Waxy Feel to Core
718								719.65 - Surface of parting glosses
719								
720		4 PP's	.20 .30					720.2 - med. grade Very Rich, Waxy Feel
721								721.72 - 721.84 x 0.12' of tuff ss bearing hydrocarbons, It is distorted & has
722								ALSO DISTORTED SHALE BEDS ABOVE & BELOW IMMEDIATELY
723								
724								
725								-9
726								
727								
728								
729								729.3
730								730.3 730.6 - 730' tuff ss (slightly distorted)
731			.03 .15					731.25
732								732.1
733								0.1 shale (low to med) with occasional thin ss seams
734								-734.1 734.2 - 734.4 tuff ss with hydrocarbons

NOTE: OTHER CORES WERE INDUCED BY HAMMER & ARE NOTED AS ON CORE

Recovered 19.73/20 Object 3:45 PM 10/23/74 (R. 23/19.73) End 10/24/74

Finished coring 6:20 P.M.

Upper Ferruginous Chert (11 to 15') is mostly brec. - fg. hematite cemented chert fragments. Lower Ferruginous Chert is fine ver. banded (cream) partially filled w/ qtz.

Upper Kona Dolomite - silty dolomite breccia, fine to med. grained, hematite cemented, with abundant chert fragments. Lower Kona is dk. gray to black fine grained dolomite.

THE CLEVELAND CLIFFS IRON CO. PROJECT: [illegible]

HOLE NO: F-1 CORE SHEET 8 OF ___ DATE: 10/27&28/74 LOGGED BY: _____ COLLAR: _____ TD: _____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	CAL/TON	REC. & RQD	LITH.	DESCRIPTION
735							++++	735.55 (0.03' of tuff ss)
736			.3					low to med grade, slightly coarser texture & higher CaCO3 content
737						737.04		~~SHALE~~, well indurated, silty buff - tan ~~to~~ ~~med~~ lt gr,
738			[illegible]					
739			.15			started coring 11:05 AM 10/27/74		
740			.85				+++	slightly disturbed bedding 740-740.8 discontinuous thin zones along break
741								
742								
743	/		.00					SHALE AS ABOVE
744								
745						1983' (604.4m) 1974' (601.7m)		
746			~.10 .40					
747								
748			.30				++	
749			.70					
750								
751			~.90					
752								
753			.10 .90					
754			.60					
755			~.20					
756								
757						756.5	++++	silty shale, tan to lt brn ~~-~~ clayey partings @ at 757.2 - finely laminated with thin dk colored bands
758								
759			.20			STARTED DRILLING 5 AM 10/28		
760			.60					
761			.10 .80					siltstone, tan - lt brn with thin dk colored bands
762								
763								
764			~.30 .70					as undulating appearance with dk wavy laths) color part.
765			.10					sandy siltstone, tan
766			duo .90				++++	siltstone, gray, banded
767								
768								
769								
770			.80			17.5' (5.3m) RUN, DRILL CLOSED 6:40 AM 10/28 RQD 42%		
771			.50 .70					
772								
773								siltstone, tan, finely laminated, uniform
774			.63 .68					siltstone, tan to pale gray to lt gray
775			.80					
776			.20					
777			.70 .70					Coal SHALE (same as above) - finely laminated to [illegible]
778			.81 .90 .80					depth of 777.05
779		.40 .20 .50						Tuff ss (777.04 to 777.9) - dark green,
780		.9 .15 .5 .15						petrolif. ~~ss~~, distinct laminated bedding, thin shale seams included
781			.67					Tuff ss (778.8 to 781.01) - dense grained dark Euta ss, petroliferous, highly disturbed, nodular mottled appearance (gypsum), brecciated
782		* .45 .80	alloy cont. ss .31					Siltstone tan to pale gray, finely laminated, with buff clay seams (<0.1), slightly calcareous
783			.81					
784								

COMMENTS: * Thin fractures are dry, tight, & cemented shut, have offset siltstone lamina, dip in opposite directions to core axis, each at ≈ 30° to horiz

THE CLEVELAND CLIFFS IRON CO. PROJECT

HOLE NO: P-4 (CORE) SHEET 9 OF ___ DATE: 10/28/74 LOGGED BY: ___ COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
785								Siltstone (as above) 782.7 to 786. has about 7° dip to core
786						19.97 Recov/20.0 cut		
787								782.7 to 790.1 all has dark seams which carry hydrocarb
788								
789			.55			RQD 12 PIECES		
790						19.85		790.1 to 793.3 dark gray siltstone
791								bedding becoming thicker
792								
793								793.3 to 794.58 light grey (thinly
794			.58			11:30 AM 10/28		Oil Shale (siltstone) siltstone bedding
795			.65					HAS A browner color than oil shale further up hole
796								795.65-795.83 - tuff ss, magnetic, high in hydrocarbons, shiny luster
797			.45			796.79		Silty Shale 803.50
798						3:00 PM Start coring 10/28/74		796.79 to 803.50 finely laminated
799								silty shale, light to dark brown,
800								dark seams often magnetic, low C
801			.05			20.00 cut RQD = 100%		hydrocarbon content but has odor.
802								800.9 to 801.1 - highly petroliferous tuff ss, strong odor, black
803								Silty Shale - finely laminated, grey (dk)
804			.67					(803.5 to 804.2) med. calc.
805			.35			19.94 Recov		Silty Shale (804.2 - 806.85) buff to light brn., Contains
806			.85					more v.f. grained sand, med. calc
807								a 0.3' ss bed at 804.85 805.1
808								805.3 (0.1') of tuff ss (brn, bleeding, odor
809								Silty Shale (806.85 to end)
810								"Sandy Siltstone" Grey colored, fine to med.
811								lamina, (varying from buff, lt grey, dk
812								grey, blk.) Most of blk
813								lamina contain magnetite
814			.55			4:30 PM Finish coring		Grain size coarsening throughout, on verge of
815								Sandy Siltstone
816			.69			816.71		
817								Silty Shale - thinly laminated,
818			.28					med. to dark grey (similar to
819			.94 .85			7:20 PM Start coring 10/28		above)
820			.32 .42					
821			.60					821.8 to 824.35
822								Oil Shale - Mahogany color, dark oil stain
823								(Silty Shale) bands distorted, med grade
824			.35					Silty Shale
825			.75			20.18 Recov/20.0 cut		824.35 to 827.1 (thinly laminated, med to)
826								dark grey
827								827.1
828								Oil Shale - mahogany colored, med grade
829			.60					(Silty Shale) interbedded, tuff ss, blk. bleed by gas bubbles, have strong odor
830			.65			FINISH CORING		829.5 830.25
831			.80					Silty Shale - lt color brn - buff, thinly
832			.53					dark (blk) ss (0.1') laminated, darker bands have
833			.45					base may carry hydrocarbons
834			.06 .06					834 Mudstone (834.5 to 836.28)

COMMENTS:

1 Core in two sections diamond sawed & thinly hand to break; 2 hit by driller's hammer; shattered rather than break along bedding

HOLE NO: P-4 CORE SHEET 10 OF ___ DATE: 10/29/74 LOGGED BY: _____ COLLAR: ____ TD: ____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	CAL/TON	REC. & RQD	LITH.	DESCRIPTION
835			.40 .83					Mudstone (cont) – Buff colored, very
836			.17				+++	dark tuff (6, Σ) light color zone, med. laminations
837					836.1			SILTSTONE, buff – lt. gray – lt. brn
838								with a few thin dark bands
839			~.80					
840								
841			60 .70				+++++	
842								SILTY SHALE, lt. – med brn
843								
844								
845			~.15					← thin layer of shale between SS beds
846			.80					
847								
848							+++++	
849			.30 .80				+++++	
850			.50		17.88' ABOVE, BOTTOM, ZONE, CORED			SILTSTONE, banded, finely
851			15 .65 .90					laminated, buff – gray
852								
853								
854			.30 .8					gray SS
855			.70 .75					
856			.80					SILTSTONE, lt gray, gray with grn
857			.90					blue – darker colored bands
858			.50					
859			.30		STAINED CRUMBLY CORE AREA			SILTSTONE – OIL SHALE with inclusions & lenses of dark petroliferous material
860								
861								
862								OIL SHALE – Med to moderately
863								leaf grade.
864			2.0 1.5 .8					Planar dips, clay parting
865								SILTSTONE, gray to buff with
866			15 .20					very thin bands & indistinct zones
867			~.70					of darker material – local occurrences
868								of soft sediment deformation
869								
870			.65 .90 .85				+++	
871								
872								
873			.70					SILTSTONE, blu-gray – buff
874								as above
875			.30					
876			.61				+++	
877					876.2			OIL SHALE (Low to med. grade)
878			.48					Siltstone (gray), fine to med. lamin.,
879								lt. grey to buff, some of fine lamina
880			.90		11.33' ANT – START CORE 10 for 1.1			are claystone
881								
882								
883			> .50					
884			.17 .30					884.17 Siltstone dark gray, fine bdd laminae

COMMENTS:

M.E. CLEVELAND-CLIFFS IRON CO. PROJECT: White Pine Oil Shale (Iron Co.)

HOLE NO: P-4 Core SHEET 1 OF ___ DATE: 10/29/74 LOGGED BY: ___ COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
885								Siltstone (as above)
886			.53			19.62 Recv'd/20.00 cut		886.53 Oil Shale, mahogany color,
887			.87					finely lamin., med. grade
888			.82 .35			RQD = 17.87/19.62		888.3 Siltstone - buff & brown lamina,
889			.16 .13 .75					med. thick bedding, has few v. thin magnetite seams.
890			.89					889.15 Siltstone lt. buff to lt. grey,
891			.26 .76					med lam. to 894.1 & coarse lam. below
892			.82 .08 .49					Abundant magnetite in thin seams
893			.21 .52					// to bedding (blk) & in very thin fractures
894								cutting bedding (Vert. to sub horiz., & very irregular lines)
895			.27			Finish coring 1:35 PM		
896			.61					Siltstone (Same as above), but
897						21.52		with less vert. magnetite stringers,
898								now mostly all parallel to bedding.
899								(899.0 to 899.9 - disturbed bedding)
900						Start coring 5:20 PM 10/28		
901								901 901.65 Siltstone - buff to lt. brown,
902								less magnetite bands, med.
903								laminations
904								
905						20.No Recv'd/19.96 cut		905.75 Oil Shale - mahogany color, low to med.
906								grade
907						RQD 19.74/20.16		
908								908 Siltstone (908.0 - 909.35) grayish brown, finely lam., mag. seam
909								909.35 Siltstone (909.35 - 911.28)
910								lt. buff to brown, med. laminated,
911								911.28 No dark seams
912								Oil Shale low to med. grade, dk. grey to
913								mahogany colored, richer below 914.45
914								& more finely laminated
915						8:15 PM Stop coring		914.81 - 914.97 - tuff ss, bleeding hydrocarbons
916								915.66 Siltstone (915.66 to 916.78) / buff to lt. brn,
917						916.78		med lam.
918								

COMMENTS: * Thin section at core stub many fine irregular fractures filled with many white (quite irregular) (However generally is basically Surface (410) Section [illegible] (major dip of fracs appx = to be 90° & 60°)

HOLE NO: X-1 SHEET 1 OF __ DATE: 24 Nov '74 LOGGED BY: E.C. Gentzler COLLAR: ____ TD: ____

FROM	TO	±MM	AZ. AT 10 20 30 40	GAL/MIN	DESCRIPTION
35	50				Siltstone, lt Gry, slty calc.
50	60				Sandstone, lt Gry, f to med grd, w/ much Feldspar & some Biotite. Arg to subangular grains, mod. sorted, & Calc cement
60	70				
~~70~~	~~75~~				
70	75(?)				Shale, med Brn, thinly bedded, fit fissile
75(?)	80				Sandstone, lt Gry, f to med grd
80	90				Shale, lt Gry to med Brn, thin-bedded, fissile
90	100				
100	110				Siltstone becoming Sandstone, lt gry, v f grd
110	120				Sandstone, (as above)
120	130				
130	140				
140	150				(Some ~~becoming~~ lt Brn)
150	160				
160	170				
170	180				Becoming Coarse-grd
180	190				
190	200				fine-grd
200	210				
210	220				
220	230				Shale, lt to med Brn, fissile, soft
230	240				Shale, lt to med Br (calcarious). Moulton 1200 ft
240	250				Calcarious Shale - lt Br with some sand
250	260	260			" " " " " "
260	270	270			Sandstones red br to lt br - Calc shales at bottom
270	280	280			Green Calc. Shales
280	290	290			Green Calc Shales becoming sands
290	300	300			Shale lt gr to lt br (calc)
300	310				Sandstone lt gr to br. bithumen flakes
310	320				Sandstone lt gray to brown
320	330				Sandstone " " " "
330	340				" " " " with bithumen lens
340	350				Sandstone (small sample)
350	360				ss. lt gray to br.
360	370				" " " "
370	380				ss lt gray (small sample)
380	390				ss " " with bithumen chips or lens
390	400				ss " " (small sample)
400	410				ss " " (small sample)
410	420				ss " " some blk flakes (small sample)
420	430				ss " " " "
430	440				ss " "
440	450				ss " " with visible dark br stains

HOLE NO: X-1 SHEET 2 OF ___ DATE: 11/24/74 LOGGED BY: W. MOULTON COLLAR: ____ TD: ____

FROM	TO	±MIN	GAMMA RAY 10 20 30 40	GAM/TON	DESCRIPTION
450	460				NO SAMPLE
460	470				SS LT. GRAY GRADING INTO A BR. SHALE
470	480				BR SHALE HARD AND FISSILE
480	490				BR SHALE " "
490	500				SHALE, med to dk Brn, fissile @ first but becoming less so w/ depth, & variable organic content.
500	510				
510	520				
520	530				
530	540				
540	550				
550	560				
560	570				
570	580				
580	590				
590	600				w/ minor amts. of Ss, lt Gry, fr-grnd (probably thin lens)
600	601				
601	602				Probable Nahcolite Zone
602	608				SHALE, med. to dk Brn, somewhat fissile w/ occ chips lt Brn, MARLSTONE
610	620				SHALE MED TO DK BRN. (CALC)
620	630				" " " "
630	640				SHALE LIGHT BR (HARD)
640	650				SHALE LIGHT BR GRADING INTO DK. BR.
650	660				SHALE DK. BR.
660	670				"
670	680				" " CALCARIOUS
680	690				SHALE DRK BR WITH LT BR LENS (FISSILE)
690	700				" " (697-698 KELLY BAIZ DROPPED APPROX 1-2' VOID & FRACTURE ZONE)
700	710				" "
710	720				" "
720	730				SHALE, Med-dk Brn, fissile
730	740				
740	750				
750	760				
760	770				SHALE, DK to V. DK Brn, fissile
770	780				
780	790				
790	800				
800	810				
810	820				
820	830				
830	840				
840	850				
850	860				
860	870				

CLEVELAND CLIFFS IRON CO. PROJECT: [illegible]

HOLE NO: X-1 (CORE) SHEET 1 OF 6 DATE: 27 Nov. '74 LOGGED BY: E.C. GENTZLER DOLLAR: ____ TD: ____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION

HOLE NO: X-1 SHEET 2 OF 6 DATE: 12/2/79 LOGGED BY: W. MOULTON / E.C. GENTILE COLLAR: ____ TD: ____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
900			.30			100.11		OIL SHALE MED-DK BRN
901			.34				+++	FINELY LAMINATED WITH SOME
902	+100						+++	SANDY LENS
903		VERT.						
904							+++	904.05 - 904.20 SANDY LAYER
905								
906								
907		907.30						
908							+++	908.53 - 908.95 SANDY LAYER
909								
910								
911								
912	+90							
913								
914								
915								
916			.01				+++	916.14 - 916.34 SANDY LAYERS
917							+++	917.50 - 917.96 " "
918								
919								
920			.53				+++	920.95 - 921.05 SAND LAYERS
921								
922	150		.85					
923								923.70 - 923.X SANDY LAYER
924								
925								925.56 - 925.71 SANDY LAYER
926								
927								
928								
929		LOST	.00					
930		.10						
931			.76					931.96 - 932.19 LAST .23 FEET OF CORE
932	+70		.19					
933								OIL SHALE MED TO DK BRN WITH
934			.43					FINELY LAMINATED WITH INNER
935			.44					BEDDED SAND LENS.
936								932.44 - 932.56
937			.60					WELL BEDDED WAVEY BED
938								CONTORTED SAND LAYER
939			.40					
940			.71					
941								941-944 DARK BRN BANDS OF
942	160							RICHER? OIL SHALE
943								
944								
945								945-949 DARK BRN. BANDS OF
946			.50					OIL SHALE (SOME BLACK)
947								
948			.38					
949								

LOOK A

OIL SATURATED W/H

HOLE NO: X-1 SHEET 3 OF 6 DATE: 3 DEC 74 (4 DEC '74) LOGGED BY: W. MOULTON E.C. GENTZLER COLLAR: ____ TD: ____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
950		.09	.32					OIL SHALE DARK BRN TO BLACK
951		.21	.74					FINELY LAMINATED WITH SOME
952	+50							INNER BEDDED SAND LENS
953			.58					
954			.67					
955			.88					
956								LOST CORE 957.11 TO 957.30 (.19' LOST)
957								-NOT RECOVERED ON BOTTOM & RECOVERED ON
958			.71					NEXT RUN. -GCG-
959		.00	.73					
960		.44						
961								SHALE-SILTSTONE, V. thinly & silty mod calc mod dk brn, f lam.
962	+40							w/ 1' thin py-lam layers, occ. v. thin pods of
963								Bitumen, & thin tuff-ss beds (freq w/ bed oil
964								
965								Low Grade (oil) zone (965.10-.75) w a thin
966								Tuff SS (965.24-.27), highly contorted lower con
967								tact & Oil Saturated
968			.61 .78					Low Grade Zone (968.55-969.35)
969								SHALE (as above) but lt-med Brn.
970								Contains thin lens of E Lk Bitt Dolomite
971								
972	+30		.38					
973			.47 (avg)					Nahcolite (?) - thin lyse (oil) chalky, white along
974								irreg. PP (973.47) & as blebs & disseminated
975		.75	.07					layers Below this
976		.87						OIL SHALE, low grade (976.08-)
977		.55 .44	.10 .44					Med Brn & Grey w/ much Marcasite
978			.21 .51					along & lens in upper part i.e. & sid, & lam.
979								
980			.62					
981								
982	+20							
983			.32					Tuff Ss lens (983.76-.84) Oil sat, irreg contacts
984								
985								Nahcolite (?) Zone (985.37-.56), white-Buff, chalky,
986								dolomitic, w/ thinly py & lam, some oil.
987								Zone w/ many v. thin-lam. of Nahcolite, like the one
988			.68					@ 976, irreg, oil sat, Tuff SS beds & distort. ch.
989								Tuff Ss (988.75-989.15) irreg, oil Sat. & thin
990			.28					" " below w thin lyrs of Nahcolite & Dyss & dolom
991								OIL SHALE HARD WITH FINE BEDDED
992			.31 .61					LIGHT BRN TO BLACK WITH INNER BEDDED
993								ZONES OF OIL SATURATED SANDS, SOME NAHCOLITE
994								
995								AND BLEBS.
996								
997								996-1000 LIGHT BRN LOW GRADE
998								OIL SHALE WITH SOME INNER BEDDED
999								ZONES OF NAHCOLITE (OIL)

LIMITED CORE INTO HAP ZONES.

HOLE NO: X-1 SHEET 4 OF 6 DATE: 4 DEC '74 LOGGED BY: W MOULTON COLLAR: ____ TD: ____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
1000			.74					SANDY LAMERS THROUGHT SECTION
1001								ARE OOZING OIL
1002	0	1002.07	.39					1002.77 - 1002.77 SANDY LENS (W/OOZE) OIL
1003		↑ VERT FRX ZONE						HARDENING MARKER
1004								RICH OIL ZONES BELOW
1005		1005.62						
1006			.69 ITR					CONCRETE IN A SMALL SAND LENS
1007			.00 .01 .15					IRREG. BREAK
1008								1007 - 1012 DARK BLACK OIL ZONES
1009								
1010								LOST CORE ZONES / REC 22.00 / CUT 22.00 / 4 DEC '74
1011								
1012								
1013			.86					
1014			12 (.33)					1013.5 - 1013.0 many very small inclusions
1015		1015.3	52.66					1015 - 1016 HIGH GRADE OIL SH.
1016		1016.4 60°						
1017			.89					
1018								1017.67 - 70 SAND LENS
1019								
1020								(55.65' OF CORE)
1021		1021.95 to 1022.1	.01 OFFSET					OIL SHALE MOSTLY HIGH GRADE
1022	1.20	60°	.40					DARK BRN TO BLACK - IRREGULAR
1023		(.39)						THIN BEDDING WITH SOME
1024		11-42						CONTORTED SAND LENS
1025		60°	.33					
1026								.12 - .78
1027			.23					VERY BLACK OIL SHALE
1028			.41					
1029								
1030								
1031								
1032								32.23 - 33.13
1033	1.30		.11					.13 - SAND LENS
1034								
1035								BANDING SEEN BETWEEN ZONES
1036								OF BLACK BROWN AND LIGHT BRN
1037								OIL SHALE
1038								
1039								LIGHT BRN SH WITH DRK BRN BANDS
1040								SOME NAHCOLITE
1041								
1042	.40							
1043			.44					LIGHT BRN OIL SHALE
1044			.97					
1045			.38					
1046								
1047			.7					.09 .41 CALCITE LENS?
1048								
1049								

FRACTURES PREMINANTLY IN CONTACTS BETWEEN SAND LENS AND OIL SHALE

HOLE NO: X-1 SHEET 5 OF 6 DATE: 5 DEC '74 LOGGED BY: E.C. GENTZLER COLLAR: ____ TD: ____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
1050						.31@		Oil Shale, low Grade, lt-Med Brn, Hard, V. Calc
1051								
1052	-50							Med Grade Zone (1052.0 - 1053.0)
1053							H	
1054			.12 .34 .45					
1055			.67					
1056								
1057			.50					
1058								~~Fr~~ only Slightly Calc. (1058.2 - 1062.3)
1059			.40 .60 .87					Tuff. Ss (1059.95 - 1060.30) w/ ~~calcite~~ 12, Oil Sat.
1060			.62 .68				H	
1061			.83 (irreg)			= 100%		Med Grade Zone - w/ some layers (.01' thk) of high Gra
1062	-60							Tuff. Ss layer @ top bleeding oil.
1063								
1064							H	
1065							H	
1066			.10			RECOV.		Mod-high Grade Zone w. numerous thin lam of ~~Nahcolite~~
1067						29.84'		
1068			.34			- 5 DEC		
1069						5:30 AM		Nahcolite layer (1070.22-.25), chalky, wht, lam.
1070			.22					
1071			.85			CUT /		
1072	-70					29.79'		Nahcolite (??) (1073.20-.22) dk Gray ! lams in Mod-High Grade
1073			.73 (irreg)			ECG		Nahcolite (1073.48-.64) distorted, buff
1074			.12 (irreg)					Tuff. Ss (1073.64 - 1074.22), Calc-altered, Grey-Brn
1075			.50 .82 ?					~~Nahcolite + Dawsonite~~ (1075.10-.15) Tuff layer
1076							H	
1077							H	becoming silty
1078			.39					
1079						1080.10		
1080								OIL SHALE, LOW TO MOD GRADE, HARD
1081								WITH INNER BEDDED SAND LAMS AND
1082	-80							BITUMEN ZONES - BITUMEN ZONES
1083								ARE OOZING.
1084								ALL THE ABOVE ARE THINLY BEDDED
1085			.36					
1086		1083.3-1087						
1087		VUGGY	3.65					
1088								
1089			.71					
1090		(.22 VUGGY)	.22, .50, .93			REC. 61.7% 5 DEC '74		.5' SANDY ZONE WITH SULFIDE LAYER (MARCASITE ?) ALSO BITUMEN
1091		1091.3	.31					
1092	-90					32.53' cut		OOZE ZONES (LENS OR BLIBS) BITUMEN
1093						1:30 PM		
1094								
1095			.33 (76)					@ 1095.82 - 1096 SANDY LENS WITH SULFIDE ZONE
1096								@ GEN MARCITTE.
1097								OOZE ZONES (BITUMEN)
1098								" "
1099	1099 +	45 VERT	.45					" "
								VERT FRACTURE OPEN GAP

HOLE NO: X-1 SHEET 1 OF 6 DATE: 5 DEC. 74 LOGGED BY: W. MIDDLETON COLLAR: ____ TD: ____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
1100		.71						OIL SHALE LIGHT BR TO GRAY LOW GRADE
1101			.41					WITH SANDLENS ~~[illegible]~~
1102	400							1102.35 - 1103 SANDY ZONE WITH ~~[illegible]~~
1103								
1104								SOME BITUMEN LENS AND TUFF
1105			.49					~~[illegible]~~ ZONES
1106								
1107								
1108								
1109								
1110								
1111								OIL SHALE - LOW TO MOD GRADE
1112	-110							LGHT BR TO DRK BRN V. HARD
1113								THINNLY BEDDED WITH INNER
1114			.40 .33					BEDDED ~~[illegible]~~ BND SULFIDES
1115			.17					MARCITITE, PYRITE -
1116			(16)(.17)					ALSO SOME SAND LENS
1117			(.01) .2 (.9)(.52)(.73)(.53)					
1118			(.99)(.56)					
1119								} MARCITITE (THIN .01'
1120								
1121								
1122	-126		.35					
1123			.15					
1124			.11					
1125			.26					} MARCITITE THIN .01'
1126								
1127			(.16)(.67)					.16-.67 SANDY LENS W/MARCITITE
1128			.05 .19			100%		.05 - .19 " "
1129			.31 (.60)					.30 - 1150.13 " " W/MARCITITE
1130								
1131			(.53)(.90)					
1132	-130	1.98	.05					~~[illegible]~~
1133		1.34	.33 .79					BLACK SAND? .50 - .69
1134			.76					
1135			.12					
1136								
1137								
1138			.30					
1139			.15 (.53)					
1140	-138							MOD GRADE OIL SHALE
								END

HOLE NO: X-2 SHEET 1 OF 1 DATE: 11/24/74 LOGGED BY: G.D. AHO C.J. HANSON COLLAR: ____ TD: ____

FROM	TO	±MM	GAIN/LOSS	DESCRIPTION
0	7			OVERBURDEN
7	22			
22	30			Siltstone, Brn, mod. calc.,
30	40			siltstone, Brn, slightly calc.
40	50			siltstone, lt. Brn., slightly calc., pyrite, carbon flecks
50	60			siltstone, Brn., pyrite, slighty calc.
60	70			Siltstone, Brn., slightly calc., pyrite
70	80			Siltstone, lt. brn to grey, arg., slighty calc., few carbon flecks,
80	90			siltstone, brn to dk grey, mod to thinly laminated, sl. calc, mica on ff.
90	100			Siltstone, brn, mod calc., with buff f.gr. SS
100	110			SS, f.gr., grey, non calc (Some mod gr.)
110	120			Siltstone, brn to dk brn, mod. calc., V. minor Mica flecks
120	130			Siltstone, brn to dk brn, mod calc, Mica on ff, buff, f. SS, mod calc
130	140			siltstone, dk brn, mod calc, mica flecks (w occasional f. to M SS)
140	150			Siltstone, Brn to dk brn, sly calc., mica flecks
150	160			SS, f.g., buff, mod calc, pyrite w siltstone, dk brn, sly calc.
160	170			Siltstone, f. lam, lt to dk brn, sly. calc., Mica flecks
170	180			siltstone, dk brn, mod calc,
180	190			siltstone, dk brn. & SS, lt. grey, w Hearber flecks & pyrite
190	200			SS, lt to med grey, pyrite, Hearbe- flecks
200	210			SS, lt grey, f.g. & siltstone, dk brn
210	220			Siltstone, dk Brn, w. calcite & nahcolite ped & SS, buff, calc
220	230			siltstone, dk Brn, nahcolite blebs, mod calc.
230	240			Siltstone, brn to dk brn, nahcolite, sl to mod calc., minor buff SS
240	250			Siltstone, dk brn, abund. nahcolite & calcite (highly alt.)
250	260			(Same as above)
260	270			siltstone, brn to grey, non calc, w calcite & pyrite X-tals on surfaces
270	280			Silt-tone, dk brn, calcite colitic texture, nahcolite, cal & effervesces but not co
280	290			Siltstone, dk brn, mod to sl. calc (Mowlstone?) nahcolite geds
290	300			Siltstone (Marlstone) brn, mod to sl. calc, w some dk br. v.f.g. SS
300	310			Sandy Siltstone (Qtz & pyrite grains), lt brn, mod calc, w some dk brn siltstone
310	320			Siltstone, dk brn, w calcite & nahcolite blebs, mod calc, w buff f.g. SS
320	330			siltstone, dk brn, thin lam, mod to sl. calc (Marlstone), w minor calcite & Hearb
330	340			Siltstone (Marlstone), dk brn, mod. to sl. calc, w calcite & minor Hearbon & Siltst, buff, f.g
340	350			Siltstone (Marlstone) brn, mod to sl. calc., w, minor calcite & Hearbon
350	360			siltstone (Marlstone) lt. to dk brn, mod. to sl. calc, minor pyrite
360	370			(Same as above)
370	380			siltstone (Marlstone), brn, mod to sl. calc
380	390			siltstone (Marlstone), dk brn, mod calc., w calcite & pyrite X-tals
390	400			siltstone (Marlstone) dk gray to brn, thin lam, mod to sl. calc.
400	410			Siltstone (Marlstone) dk gray to brn, mod to sl. calc, minor pyrite, Hearbon, & magnet
410	420			Siltstone (Marlstone) grey to brn, mod calc, w gilsonite, Hearbon, & pyrite lbes
420	430			Siltstone (Marlstone) dk brn, mod to sl calc
430	440			Siltstone (Marlstone) dk brn, mod to sl. calc
440	450			Siltstone (Marlstone) dk brn, mod calc, w pyrite
450	460			Siltstone, dk brn, sly. to mod. calc, mica on ff, minor gilsonite & carbon
	460			11/26/74 START CORING

... IRON CO. PROJECT: BOISE CASCADE KANE RIVER ...

HOLE NO: X-2 SHEET 1 OF ___ DATE: 11/27/74 LOGGED BY: G.T. HANSON G.D. AHO COLLAR: 5010(') TD: 765.8

DEPTH	±MM	FRX		REC. RQD	DESCRIPTION
					DRILLING CONTRACTOR: LAYNE WESTERN
					RIG: GD 2000
					DRILLERS: COX (NOON-7), KAUZLARICH (MIDNITE-NOON)
					METHOD: Air Mist; 6 3/4" Christenson Bit
					SERVICE CO: WESTERN AIR.
					GEOLOGIC SYMBOLS:
					tuff ss
					NAHCOLITE
					BITUMEN FLECKS
					HIGH GRADE OIL SHALE
					HEMATITE, PYRITE, OR MARCASITE layers blebs, or fine sized X-tals
				460.0	
460					OIL SHALE (siltstone / marlstone)
461				12:00 NOON START CORE 11/27/74	v.f. lam., dk gray to brn with occasional buff lamina, generally
462					med. eff. (higher grade zones are
463					MAHOGANY color) few thin tuff ss
464			4.20		4.65 lamina as noted.
465			5.90		5.47
466					
467					464.20 - tuff ss, gray & dk gray, 0.02'
468				19.79 cut Section = 100	464.95 - tuff ss, dk brn, w Hcarbons, 0.05'
469			9.50		466.30 - same ss as above, 0.05'
470					
471			1.58	19.61 RQD	471.58 - tuff ss, dk gray, 0.07'
472					
473					
474			4.40		474.40 - tuff ss, dk gray, v. thin, irregular
475					
476					
477			7.97	2:30 PM Step Core	477.97 - tuff ss, dk gray, 0.05
478			8.04		8.95
479				479.76	
480					OIL SHALE v. f. lam., dk to brn, generally
481				4:45 P.M. START CORE 11/27/74	med. eff., w/ V. thin tuff ss lam,
482					(thicker ones noted)
483					479.88 - (0.02') tuff ss, brn & Hcarbons
484					479.97 - (0.03') tuff ss, brn & Hcarbons
485			1.5		481.5 - (0.05) tuff ss, gray
486				22 cut	6.8 481.92 - (0.02') tuff ss, gray
487					488.0 485.09 - (0.01') tuff ss, dk gray
488					488.97 - (0.02') tuff ss, gray

THE CLEVELAND CLIFFS IRON CO. PROJECT: Bonus Creek Property

HOLE NO: X-2 SHEET 2 OF ___ DATE: 11/27/74 LOGGED BY: G.D. Ahlo / C.J. Hanson COLLAR: _____ TD: _____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
490			0.4					Oil SHALE (45° above)
491								
492								490.4 - (0.03') tuff ss, gray
493						RQD=100		492.55 491.34 - 491.74 buff color, siltstone, v.f. lam, mod eff. 494.6
494								
495								Oil Shale - below 491.74 (buff zone) the color becomes darker brn to end of run, f lam, mod. calc. oil shale
496								
497						7:30 AM STOP CORE 11/27/74		
498								
499								
500						500.0		Oil SHALE - predominately dk brn w
501								500.92 501.95 some dk gray lam, v.f. lam, mod. to st. efferv., low to med grade except where noted.
502								
503			3.62			12:45 PM START CORING 11/27		
504								500.83 - tuff ss (0.1'), lt. brn w/ dk brn
505								502.18 - tuff ss to 502.28 (≈ 0.1'), dk brn, distorted contacts, w/ shale
506								
507								503.6 - dk brn, dk brn tuff ss (0.05')
508						CORE GROUND UP & RECV. POOR & RQD undeterminable		508.23 - tuff ss (0.05') dk brn, w/ shale
509								509.00 - tuff ss (0.05') } false ble thick's,
510			0.61					510.15 - tuff ss (0.20') } color
511	+130							510.61-519.90 - left in bottom of hole & recovered actually with next 6'. However - much of core was ground up & pieces recovered were badly
512								
513								
514								
515						7:15 PM FINISH CORING		broken. Most of it is dk brn Oil Shale (silty shale) mod. to st. effer. ≈ 4' of sample recv. out of 9.3' cut, but largely due to faulty core catcher
516								
517								
518								
519						520.0		
520						6:20 PM START CORING 11/29		Oil SHALE - brn to dk brn w. few thin buff lamina, v.f. lam, mod. to st. calc, low grade.
521	+180							1.3 2.0
522								
523								
524						7:30 AM 523.8 ft/STOP RQD=100		524.45 } tuff ss (0.08') - dk brn tuff s
525								& 525.3 (0.1') carrying hydrocarbons, wavy contacts
526						525.98		Oil SHALE - brn to dk brn. w. tuff ss as noted. Mod calc., v.f. lam. Higher grade zones for oil shale. Mahogany colored, few thin buff color. laminae.
527			7.77					
528								
529			9.09			12:30 PM START CORING 11/30/74		
530			0.05 0.57 0.88					Tuff ss: 530.58-6.86 dk. brn, wavy contacts, 527.11-7.70 dk. brn, wavy cont's, calc 528.75-8.80 dk brn, wavy cont's
531	+110							
532								
533			3.97					
534								
535						20.1 rec/20.0 cut RQD = 19.2/20.1		530.7-0.95 dk brn, wavy cont's, calc 535.77-6.33 (same as above) 536.47-6.53 (" " ") 537.00-7.09 (" " ")
536								
537								
538			8.97					
539		65°	9.31					

COMMENTS:

Note: Core from 500-529 came out with only 10.61' due to shift, because of thinning of core & stopping at 11:28 to maintenance crew. Had one shift because of thinning of core & stopping at 11:28 to maintenance crew. Had to drill another 6' & 525.98 ft. Went back in over core & ground

HOLE NO: X-2 SHEET 3 OF ___ DATE: 11/30/74 LOGGED BY: G.D. Aho C.J. Hanson COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
540							+ + +	Oil SHALE brn to dk brn, mod calc, v.f. lam, w few buff lamina.
541	+100							
542			2.07				+ + +	Tuff ss { 542.18-0.23 dk brn, wavy
543								542.56-2.63 contacts, w
544		45°	4.15 4.20			3:25 PM STOP CORE	+ + +	544.17-4.20 Hycal, ns, Semi
545							+ + +	545.69-546.10 } gilsonite, odor
546						10 3/4" S.M. 546.0 START CORE 12/1/74		Oil SHALE — brn to dk brn, f. lam,
547								med. to St. calc, low grade
548								
549			9.68				+ + +	Tuff ss { 549.53-9.60 dk brn, wvy,
550								549.78-9.88 contacts, w
551	+90							554.58-4.65 Hycarbons, gilsonite
552								Hicks, odor
553						20.18 / 14.97 cut Rec RQD = 100		1.89
554			4.62				+ + +	2.43 Silty Shale - buff colored, St. calc., low grade
555								(555.85 to 556.85)
556			6.0					Oil Shale - brn to dk brn, f. lam., mod to St.
557								calc., low & med. grade
558			3.09					
559								Tuff ss 561.43-1.48 (brn, [illegible] zone w
560								Hcarbons
561	+80		1.43 1.48				+ + +	tuff ss { 564.11-4.16 - dk brn, Hycarbons
562								odor
563						STOP CORING 1:40 PM		3.96 563.04
564								4.90
565			5.65				+ + +	Tuff ss (565.01-566.71) - tan to brn
566			6.61			565.48	+ + +	6.11 to dk, low Hycarbons, mica & magnetite
567			7.84					grains, highly distorted bedding & contacts
568						START CORE 3:45 PM 12/3/74		non-calc. UPPER WAVY DEP
569							+ + +	Oil Shale (6.71 →)
570								brn to dk, f. lam., mod calc, low to
571	+70							med grade oil shale, few v. thin
572			2.90					high grade seams - larger ones noted.
573								3.20 3.63
574								Tuff ss.'s
575						14.97 Rec / 20.01 cut		569.08 (.02') } dk brn, v.f. Hc
576								575.62 (.02') } Hycarbons
577						RQD = 100		
578			8.10					
579								
580								
581	+60							
582								
583						STOP CORE 7:00 PM		
584								
585						585.99		Oil Shale - brn to dk. brn, f. lam., mod.
586								6.91-6.96 effer., med. grade oil shale. W.
587						START CORE 11:30 AM 12/4/74		few higher grade zones
588								
589								

m 12/3/74, Tabbed and rounded as log.

HOLE NO: X-2 SHEET 4 OF ___ DATE: 12/4/24 LOGGED BY: G.D. Ano C.S. Hanson COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	CAL/TON	REC. & RQD	LITH.	DESCRIPTION
590								Oil Shale (as above, continued)
591	+50							1.60
592								W. few buff colored seams of
593								3.20 silty shale as listed: (594.55-4.60)
594								(602.18-2.24)
595						20.01 Rec/19.56 cut		(605.38-5.45)
596						RQD = 100		
597								
598								
599								9.32 Tuff ss. (599.69-599.75)
600								0.59
601	+40					Start Core @ 2:05 AM 12/4/24		
602								
603								3.43
604								4.46
605								
606						Core 97		Oil SHALE - low grade, silty shale, brn
607			7.15 7.39					to buff, w calcite filled cavities
608								(607.25 to 611.88) — calc fe
609			9.20			Start Core @ 8:30 AM 12/4/24		cavities from (611.55-611.10)
610								Oil Shale
611	+30		1.30					1.88 gray to dk. gray, med. grade oil
612			2.46					shale from 611.88 to 617.85 w.
613			3.18					higher grade zone from
614			4.55 4.80			19.85 Rec/20.02 cut RQD = 18.14/19.35		617.85 to 621.23
615								
616			6.00					LENSES & BLKS of tuff ss
617			7.42					7.85 from 621.40 - 623.50
618								
619			9.37					Oil shale shows irregular, wavy, lamina
620			0.26					from 620.09-625.00
621	+20							1.23
622						Step core @ 8:05 AM		Oil Shale - dk brn to gray low to
623			3.04					med grade oil shale, mod
624								calc.
625			5.10					5.31 Tuff ss, bedding & carbons (624.74-4.11) (625.05-5.09)
626			6.05			625.99		Oil Shale (625.31-627.80) (625.23-5.31)
627								7.80 brn to dk brn w some buff lamina,
628								mod to stf-ftr, med. to high grade oil
629						Recovered Short Core 12/4/24		shale, thinly laym & distorted bedding
630								0.16
631	+10		1.34					Mahogany Marker (?)
632								1.68 626.04-6.40 tuff ss, dk brn to dk gray, distorted
633								626.44-6.48 contacts, calcite mg net. w
634						19.99 Rec/19.56 cut RQD = 100		626.80-6.89 minor Hydrocarbons
635			5.29					631.18-631.98
636								631.98-632.13
637								Oil Shale (631.68-637) low to med grade,
638			8.19					tan to lt brn., med to stf-ftr,
639			9.80					

THE CLEVELAND-CLIFFS IRON CO. PROJECT: [illegible]

HOLE NO: X-72 SHEET 5 OF ___ DATE: 12/4/74 LOGGED BY: G.D. ANC C. Tschanson COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
640			0.42					Oil Shale (637→) lt to gray, thinly lam., low to med grade, mod. effer.
641	0		1.67					
642								
643								Tuff ss
644								641.13-641.18 f grained, dk brn
645			5.67			1:45 PM stop coring		
646						45.97	6.0	641.45-1.50, 641.71-1.73 } lt blk, magnetite, minor Hydrocarbons
647						START CORE 4:15 PM 12/4/74		Oil Shale - buff to lt brn to reddish
648							7.83	dk brn, f. lam., mod. calc., med grade, with higher grade zones
649								
650			0.13					being mahogany to black in color
651	-10		0.43				0.9	
652								Thin (0.02') tuff ss, lt grey at 653.0
653								
654			4.03 / 4.88					
655						16.00 rec / 19.98 cut RQD 12.05 / 16.00	5.0	
656								
657								CORE BADLY BROKEN - MANY v. thin poker chip pieces, apparently zone of lost CORE, all pieces are high grade oil shale
658			Spec Nat (2)					
659								
660							0.70	
661	-20		1.25				1.67	ZONE of solid crystals of Manganoan calcite, highly effer., only partially dissolved, some of crystalline material is translucent brn - a vitreous to waxy luster - A very distinctive zone
662			1.50 / 2.10 / 2.30					
663			3.0 / 3.45			Stop coring 7:20 PM	3.48	
664			4.30				3.97 / 4.30	
665							5.74	Tuff ss - 665.74 - 665.95 lt brn to waxy reddish
666						66.95	6.0	Oil Shale
667								dk brn to mahogany to blk, high grade oil shale, f. lam., mod. calc. - Higher grade
668			3.30				8.13	
669			4.70					zones only slightly effer.
670							0.40	
671	-30		1.56					
672			2.76				2.62	
673			3.74 / 3.95 / 4.13	.38 / .83 / .91				
674							4.21	
675			5.21 / 5.63				5.58	
676			6.38 / 6.91				6.31	
677			7.34 / 7.62	.91				
678			8.22 / .55					
679			9.50 / .93					
680			0.44 / .95					Oil Shale - dk brn, f. lam, mod. calc., low to med grade (680.0-684.55)
681	-40		1.33 / .68					
682			2.11 / .41	.91				
683								684.55 to 685.47 wavy bedding in oil shale
684			4.13 / 4.55				4.55	
685			5.47			6:15 → Start core 12/5/74	5.47	Oil Shale buff to dk brn, f. lam., mod effer., low to med grade except where higher grade noted.
686								
687								
688			8.25					
689							9.23	

COMMENTS: * Est. core apparently left on bottom from last run, had to advance footage marked in core (RQD = 44.5% - 2.05')

THE CLEVELAND CLIFFS IRON CO. PROJECT: [illegible]

HOLE NO: X-2 SHEET 6 OF ___ DATE: 12/5/74 LOGGED BY: G.D. Atto C.T. Hanson COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
690								0.45
691								
692							+++	2.38 2.58-2.70 – lt. brn tuff SS w/
693						20.11 Rec/19.97 cut RQD = 100		3.77 blk chlorite & calcite
694			4.33					
695								
696								
697								
698			8.68					
699								9.14 9.27
700			0.25 0.91					
701	-60					Strip core E-20 mm 12/5/74		
702								2.05 702.82-2.87 } Tuff SS - dk gray
703								3.35 703.08-3.12 } to brn, w/ gn lith.
704			704.74 4.92			704.74		Oil shale pyrite & hyd. lams
705						12:00 noon Start core 12/5/74		704.74 to 707.80 [illegible] lam, rnd.
706			6.20 .23 .41					lt brn to buff, f.t.m, med. effer.
707								Oil Shale, med grade, tan to dk
708			8.33					8.85 brn to dk gray lamina - light
709								9.15 color zones more highly effer. th
710			0.31					dk. Higher grade zones are
711	-70							chocolate to blk
712								2.4
713								3.56 Tuff SS's { 708.11-8.64
714			4.11			19.58 Rec/19.97 cut RQD 15.58/19.58		dk gray to dk brn, some mag. & hydrocarbons, calc { 709.85-8.87 710.31-710.58 712.23-2.36
715								
716			6.36					
717								7.4 715.45 to 717.4 - lt gray to tan
718			8.25					8.8 to lt brn oil shale, med
719			9.25					9.36 grade, mod effer.
720			0.60 0.74 .44					Oil Shale (720.6-723.76) – lt. gray to
721	-60		1.08 1.35					buff colored zone, low grade,
722			2.05 2.71			2:15 pm Strip core		med. lam., mod. calc., feel of
723			3.56					3.66 mudstone
724			4.26					4.77
725			5.18			724.84		5.35 Tuff SS - 725.67 - 726.0, lt. brn
726								6.90 to gray, hydrocarbons, wavy
727								contacts & bedding
728			8.19			Start core 5:15 PM		8.89 Oil Shale, lt brn, lt gray, & buff lamina
729								low grade, mod calc, med. lam.
730			0.25 0.34					
731								Tuff SS - 728.47-8.53, dk brn,
732								some hydrocarbons, magnet.
733			3.18 3.46			20.66 Rec/20.02 cut RQD = 100		
734								
735								
736			6.33					6.70 6.96
737								
738			8.84					
739								

CLEVELAND CLIFFS IRON CO. PROJECT: [illegible] SHALE

HOLE NO: X-2 SHEET 7 OF ___ DATE: 12/5/74 LOGGED BY: G.D. AHO C.J. HANSEN COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
740						stop coring 8:15 AM 12/5/74		Oil Shale – low grade (same as above)
741								
742								
743			3.29					
744			4.64				+++	Tuff ss 744.60–4.71, dk brn,
745						744.84		minor hycarbons
746								Oil Shale – buff, lt. brn., lt. GRAY, thin
747								lamina, mod. calc., low grade, w.
748								minor Hycarbons, pyrite, mahcolite
749								
750								
751							+++	Tuff ss (751.00–1.21), dk brn. w small
752								amt. of bleeding Hycarb
753								
754								754.00
755								755.00
756								
757								Tuff ss (757.22–7.45), dk brn.
758								with excessive bleeding "gas bo
759								Oil Shale shows irregular wavy lamin
760								in following intervals (746.0–748),
761	-120							(750.0–750.25)(756.35–6.71)
762								(762.0–764.05)
763								Mahcolite VUG (763.0–763.52)
764								
765								T.D 765.84 (6:30 AM, 12/6/74)
766								

HOLE NO: X-3 SHEET 1 OF ___ DATE: 1/17/75 LOGGED BY: D. Stanbuck COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION

HOLE NO: X-3 SHEET 2 OF ___ DATE: 1-17-75 / 1-18-75 LOGGED BY: D. Starbuck / E.C. Gentzler COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
350			.15					OIL SHALE - MEDIUM Grd To 350.10
51				351.90				OIL SAT TUFFAC. SS. (350.40-.18)
52								OIL SHALE: LOW GRADE CALCAROUS
53			.20	.90				
54			.83					
55			.78					
56			.80					
57								
58			.29					SS (358.29-.95)
59	+110		.39					
360			.76					OILY SILTSTONE LENS (360.10-.18
61			.65					
62			.20					CALCARIOUS TUF. S.S. (362.05-.35)
63			.83					OIL SAT. TUF. S.S. (363.42-.16)
64								" " " " (365.42-.47
65			.40	.64		REC 30.63 9:00 PM 1-17-75		
66			.59					
67								
68			.94					
69	+100		.70					
370			.86					
71						CUT 30.50' STARBUCK		TUF. WAVY CALCEROUS SS BED (371.45-.94)
72								
73								
74			.00					
75			.98					375-378 OIL SHALE, gray-brown, v finely lam hard - competent with several thin intermittent inclus of tuff.
76								
77			.19					DARK SILTSTONE LENS (377.15-.20)
78			.68					
79	+90							
380			.44					SS TUFF. dk gy-brn lmtd in cont. bnt thgn. LIGHT TUFFACEOUS SILTSTONE BED with Sh of top & undulating at top - saturated with illuation (380.20-.60)
81			.40					
82			.18	382.40				
83			.14					SHALE, lt-med Brn, silty, mod. Calc, v. hard
84			.15					Containing thin altered tuffs SS (Gen. oil impregd) v. hard & thinly lam
385			.97					
386			.92					
387								
388			.77					
389	+80							
390			.01 .98					
391								
392						CUT 27.75' — REC 30.26' — 12:30 AM 1-18 JAN '75 — ECG		
393								
394								
395			.28.32					
396			.56					
397			.67					
398			.96					
399	+70		28.31.97					Upper wavy bed (399.00-400.00) Contorted,

COMMENTS: THE CORES ARE STORED ON THE RACKS IN THE CORE STORAGE BUILDING AT THE OIL SHALE EXPERIMENTAL MINE. THE CORES ARE ARRANGED IN SEQUENCE FROM THE TOP OF THE HOLE TO THE BOTTOM. THE INTERVALS ARE MARKED ON THE CORE BOXES.

HOLE NO: X-3 SHEET 3 OF ___ DATE: 18 JAN '75 LOGGED BY: E.C. GENTZLER COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
400			32.60					Oil seepage & minor Gilsonite
401			.34					
402			.60					
403			.09, .72					
404			.77					
405								
406			.46					
407								
408			.00					
409	+60		.61					
410								
411			.69					
412						412.36		SILTSTONE-MARLSTONE, lt-med brn, thinly lam. & thinly bedded, slightly dipping bedding, w/ some microfaulting, hard, mod to v. calc.
413		.70	.57 .70					
414		87°						
415		.30						½ cc bands of py-hem, & a few zones of low grade oil enrichment. ½ cc cuts of Asphaltite (?)
416			.15					
417			.33					
418								
419	+50							
420								
421			.33					
422			.85					
423								
424			.26					
425			.64			30.05' + EOC		
426				.61				
427			.42					
428			.56	.512				
429	+40			.55				
430						REC 18.1' JAN '75		
431								
432			.58					
433				.58				
434			.53					
435			.71	.53		CUR 29.74' 7:20 AM		
436			.67	.915				
437			.32 .65	.67				
438			.47 .63	.33 .65				
439	-30		.00 .77	.01 .62				
440			.00 .44	.09 .26				Small vugs (.02-.05 dia) filled w/ earthy dk brn clay
441			.44 .47	.46 .53		442.10		
442				.14 .57 .66 .86				
443			.65					LOWER MEDIUM GRADE SHALE CREAM TO DARK BROWN-TAN OF HIGHGRADE SHALE. SOME SAND LAMINAE & OIL SATURATED ARE FOUND IN RUN.
444			.07 .63					
445								HIGHER GRADE SHALE DRKER THAN
446			.11					
447			.35					
448			.23					
449	+20							

HOLE NO: X-3 SHEET 4 OF ___ DATE: 1/K/75 LOGGED BY: W. MOULTON COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
450			.12					
51								
52			.21 .92					MEDIUM GRADE SHALE
53			4.67 .98					
54			62.94					
55			[illegible]					455.00 - 457.00 INTERBEDDED SHALES AN
56								SANDS - PREDOMINATELY SANDS
57			.56					SOME ZONES OIL SATURATED
58								
59	+10							
460			.94					MEDIUM GRADE SHALE
61								
62			.05					
63								
64			.60					
65								LOW GRADE SHALE
66			.72					TO MEDIUM
67								
68			.74					
69	0							469.52 - .92 MAHOGANY MARKER
470								OIL SATURATED SAND
71								
72				472.00				
73			.18 .37 .85					MEDIUM TO HIGH GRADE - BROWN
74			.10 .43					TO BLACK MAHOGANY ZONE
75			.88					INCLUDED IN THIS RUN.
76								
77			.61 .19					
78			.13 .25					
79	-10							
480								
81			.83					
82	-13		.34 .10 .48					
83			.21 .63 .87					
84			.89					
85			.22					
86			.21 .92					
87			.42					
88			.76					
89	-20		.55					
490								
91								
92								
93								
94			.50 .62					
95								
96								
97			.03 .10 .12					← SANDSTONE - SILTSTONE (497.62-.72)
98			.40					
99			.94					

COMMENTS:

HOLE NO: X-3 SHEET 5 OF ___ DATE: 1-18-75 / 1-19-75 LOGGED BY: D. Stanbuck / E. Gentzler COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
500								OIL SHALE: MEDIUM TO HIGH GRADE
1								"
2								" CALCEROUS
3			.57	1.05	.80' 504.10			"
4			.97					"
5			.20	.93				"
6			.34					"
7								
8			.38					SS (508.38-.41)
9	-40		.76					OIL SHALE - MEDIUM GRADE
510			.10	.85				"
11			.13					"
12			.10					"
13			.15					"
14								"
15								"
16								"
17			.23					"
18		VERTICAL						"
19	-50							"
520								"
21			.12					"
22		521.05	.21					OIL SHALE - MED GRD - CALCAREOUS
23		523.73	.73					"
24			.30					"
25			.24					"
26			.36	.53				"
27			.60					OIL SHALE - LOW GRD CALCAREOUS
28			.10	.53 .92				SS - SILTSTONE 528.58-.67
29	-60		.36	.53 .91				
530			.37	.65				
31			.25					
32			.00					
33			.09	.53				SS W/ OILY BANDS (533.53-.97)
534			.30	.92	534.60			SILTSTONE - MARLSTONE, V.lt-Med Brn, occ Gry, thinly lam., hard, mod to v. calc., w/ some low Grade oil enrichment
535			.46					
536								
537			.70					
538								
539			.15					
540			.81					
541								
542								
543			.09 .29 .73 .91					
544			.20 .37					
545			.09 .81					
546			.45 .85					TUFFSS (546.72-547.33) Coarse-grd, oil stained, Calcareous, containing Marlstone lenses
547			.30 .55					
548			.11 .80					
549			.02 .12					TUFF SS (548.38-550.00) Coarse grd, oil, stained

- 30.50' CUT - 30.55' REC. 100% REC - 1 EOB

CUT 5 CYSP 1-18-75 REC 30.40 5 STANDBUCK

COMMENTS:

HOLE NO: X-3 SHEET 6 OF ___ DATE: 11 Jan '75 LOGGED BY: E.C. Gaither COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
550								
551			.76					
552								
553			.09					(553.37-40) Tiny Nahcolite(?) aggs in sh.
554		.73 @ 35° .37	.73					
555			.39					
556			.52					
557			.39					
558			.56					
559			.34					
560		.72 @ 85°	.72					
561			.76					
562								
563								
564			.78.89			565.10		
565								Tuff Ss. (566.12-.29), oil sat.
566			.29					
567		HEALED .55 .03 .50 .45						Slightly distort. bed, & bed. offset .03' along healed 55° frx.
568								
569	-100		.82					
570		.04 .00 45 45 HEALED						LIMESTONE, lt Gry-Brn, med gnd, thinly lam., dolomitic in zones, low Grade oil in z. & containing occ. oil bearing tuff Ss layers. Also pods & lam of Py-hem & occ vugs of earthy nahcolite (?)
571								
572			.17					
573			.08					
574								
575								
576			.00 .73					Tuff Ss (576.98-577.10) & (577.37-.57) lt altered, oil stained, & containing nahcolite (?)
577			.08 .57					
578		.27 INCRT .12	.57.72			26.72 REC. 26.00' CUT 5.15 DMM 1.35		
579								
580			.41					
581								Intra-formational breccia, (581.92 - 582.05)
582			.03					Vugs of earthy Nahcolite(?) & oil.
583			.25					thin lam. of Py-hem
584			.45					
585		.37	.08 .93					
586			.60 .82					
587		88° TAR COATED	.70 .96					Top of Massive Py-HEM layer (587.90-.96)
588								Distinctive Coated vert. frx.
589	-120		.90.94					
590			.74					
591						T.D. = 591.10		

HOLE NO: X-1 SHEET 1 OF 1 DATE: 1-1-75 LOGGED BY: [illegible] COLLAR: [illegible] TD: [illegible]

FROM	TO	±MM	AZIM 10 20 30 40	GAL/TON	DESCRIPTION
150	190				
	200				
	210				
	220				
	230				
	240				
	250				
	260			L.S	LT. GR. SILTSTONE SLIGHT CFF.
	270			W.R	" "
	280				" "
	290				
	300				LT. GR. SILTSTONE & SS
300	310				LT. GRY / SILTSTONE SLIGHT CFF.
	320				"
	330				"
	340				"
	350				LT GR. FINE GR. SILTSTONE SLIGH CFF.
	360				"
	370				"
	380				LT BROWN SHALE, SOME BENTONITE, SLT. CFF.
	390				LT BROWN SHALE
	400				"
400	410				"
	420				LT BR SHALE
	430				"
	440				"
	450				LT. TO MED BROWN SHALE
	460				" "
	470				LT TO MED BROWN SHALE SLIGHT CFF.
	480				" " "
	490				" " "
	500				" " "
500	510				LT TO MED BR. SHALE WITH MINOR SS
	520				" " "
	530				MED TO DK BR SHALE MINOR WHITE MINERAL (SOFT
	540				LIGHT TO MED BR SHALE
	550				MED TO DARK BR. SHALE
	560				" "
	570				" "
	580				" "
	590				" "
	600			L.S	" "
[illegible]	610			L.S	Med to Dark BR Shale
	620				" " " "
	630				" " " "
	640				" " " "
	650				" " " "
	660				" " " "

THE CLEVELAND-CLIFFS IRON CO. PROJECT: COORS

HOLE NO: X4 SHEET 1 OF 6 DATE: 1-2-75 LOGGED BY: SUNDBERG COLLAR: ____ TD: ____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. &RQD	LITH.	DESCRIPTION
660			.3-.9				660	OIL Shale Lt br to DK Low grade
661			.58.8					Finally Laminated
662			.2-.6					
663			.12,.4					
664			.09					
665			.12					same as above - badly
666			.07.59	.13				broken up - slightly calcareous
667			.4.95					
668			.54.9					
669			.35.68					
670			.18.55	2			Recov. 24' Core	Lt BR Low grade oil shale
671			.34.59	1				slightly calcareous
672			.22.6.81					
673			.15.43	.18				
674		[illegible]	.53	.2				
675			.06.16					same as above
676			.48					
677			.37					
678			.15.2					Lt brn to Med brn
679			.15.3					Lt brn Oil shale (massive appears)
680			[illegible]	2				" "
681			[illegible]					Lt brn to Med brn Oil Shale
682			[illegible]					"
683			[illegible]	2				" "
684			[illegible]					" "
685			[illegible]	1				" "
686			[illegible]					"
687			.65					Med to Lt brn Low grade Oil
688			[illegible]					Shale Many fractures healed
689			[illegible]					Calcites.
690			.45.2	3				Low gr.
691								Lt to Med brown Low grade Oil
692								Shale Calcareous with fine
693								laminations.
694								Lt brown Low grade Oil Shale
695								"
696								"
697								Lt br. Oil Shale
698								" " .72-.80 ss Oil sat.
699			.52					Med br Oil Shale
700								Med br. Low Grade Oil Shale .18-.5
701			.65					Oil Sat. 25
702								Lt br. Low Gr. Oil Shale
703								" "
704			.56					" " .80-.90 Oil Sat ss
705			[illegible]					Lt br. Low Gr. Oil Shale
706								.77-.85 Oil Sat. ss
707	+130		[illegible]					Lt. br. Low Gr. " "
708			[illegible]					Upper br. Med Grade Oil Shale

T. CLEVELAND CLIFFS IRON CO. PROJECT: [illegible]

HOLE NO: X-1 SHEET 2 OF 6 DATE: 2-2-75 LOGGED BY: [illegible] COLLAR: ____ TD: ____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/MIN	REC. & RQD	LITH.	DESCRIPTION
710								Mod Gr. Dk Gy Oil Shale
711								" "
712		.22						Oil Sat. SS. "
713		.11						Lt. Brn Calc Gr.
714								"
715		.25						Med Gr. Med. Gr.
716		.26						"
717	+126	.19						"
718								"
719		.18	55					"
720					730.15			
721								
722								
723								
724								
725								
726								
727	+110							
728								
729								
730								
731								
732								LOST CORE
733								
734								
735								
736								
737	+100							
738								
739								
740								
741								
742								
743								
744								
745								
746		PP						
747	+90	.30 .40						Grey with Lt Brn bedding
748		.30 .10						Low to Med oil shale
749		.10 .45	.80					
750			.15 .15 .70					Med brn oil shale
751			.10 .50 .40					" " slightly
752			.15 .35 .50 .30					" " calcareous
753			.48 .47 .75					" "
754			.1 .49	4.33		5'5" 30.4'		" "
755			.25 .12 .10 .09			Rec		" " Low to Med Grade
756								" "
757	480		.04 .61					SS with Low Grade (.34 - .43)
758			.08 .31 .5 1.79					Oil Shale Calcareous
759			.21					Med Brn Oil Shale

THE CLEVELAND-CLIFFS IRON CO. PROJECT: Co. A-5

HOLE NO: X-4 SHEET 3 OF 6 DATE: 1-[illegible]-65 LOGGED BY: R. Hawkins COLLAR: ____ TD: ____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
760			21					MED. BRN SLIGHTLY LAMINATED
761			[illegible]					OIL SHALE. MED GRADE
762			32 [illegible]					SLIGHT OIL.
763			[illegible]					" "
764			[illegible]					" "
765			31 [illegible]					" "
766			[illegible]					" "
767	+70		14 [illegible]					" "
768			21 [illegible]					" "
769			[illegible]					" "
770			[illegible]					" "
771			[illegible]					MED. TO DARK BRN MED. GR.
772			[illegible]					"
773			[illegible]					"
774			15 [illegible]					774.67 - 775.37 UPPER MAHOGANY BED
775			[illegible]					MED TO DARK BRN MED GRADE
776			[illegible]					776.60
[illegible]	+60		23 [illegible]					MED TO DK BRN OIL SHALE
[illegible]			31					MED GRADE MED LT.
[illegible]			50					THIN LAMINATION
[illegible]			40					"
[illegible]			[illegible]					"
[illegible]			67					"
[illegible]								"
[illegible]								MED. TO DK BRN OIL SHALE
[illegible]								"
[illegible]			38 .60 [illegible]					"
[illegible]	+50		22 .50 [illegible]					MED TO DK BRN MED GR. OIL SHALE
[illegible]								1/2" DK RICH BANDS COMMON
[illegible]								"
[illegible]			91					MED TO DK. OIL SHALE MED GR.
[illegible]			28					"
[illegible]								LT. TO MED. OIL SHALE COM GR.
[illegible]			46					" "
[illegible]								" " 794.2 SS LENS
[illegible]			50					" "
[illegible]								796.4 TO 796.6 OIL SAT SS
[illegible]	+40		31					LT. TO MED BRN MED GR. OIL SHALE
[illegible]								"
[illegible]			34 [illegible]					"
800			61					MED TO DK BROWN, HIGH GR. OIL SHALES
801								@ 801 OIL SS LENSES
802			68 [illegible]					MED GR MED GR OIL SHALE
803			75					" "
804			[illegible]					" "
805			[illegible]					GR. OIL TO DIFF MED GR OIL SHALE
806			[illegible]					805 - 806 VUGGY ZONES WITH WHITE CLAY LIKE MIN.
807	+50		30 [illegible]					— 807.20'

CUT

RECOVERY

HOLE NO: X-4 SHEET 4 OF 6 DATE: 1-3-75 LOGGED BY: [illegible] COLLAR: ____ TD: ____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	SAMPLE	DESCRIPTION
805			.25						MED GR. MED TO HIGH GRADE
809			.3	4.48					OIL SHALE. FAINT BANDING
810			.37	.97					WEAK LITE.
811			.60						"
812			.60	.84					"
813									"
814			.90						MED GR. MED GRADE OIL SHALE
815			.90						FAINT BANDING MARKED BY
816			.50						OIL BANDS LOCALLY. LENSES OF
817	+20								SS & TUFFITE. HIGH GR. ZONES
818			.21						SLIGHT LITE.
819			.10	.19					MED GR. MED GR. OIL SHALE
820			.12						" "
821			.50						.50 - 70 OIL SHALE SS HIGHLY DISTD TUFF
822			.45						822.0 TO 822.45 OIL SHALE SS
823			.31	.65					MED GR. TO BUFF MED GR. OIL
824									SHALE 823-824 OIL SHALE SS
825			.50						BANDS.
826			.45						825.5 - 827.5 LT. BRN. HIGH GR.
827	+10		.40						OIL SHALE IRREGULAR OIL SHALE
828									SS LENSES.
829									LT. TO MED LOW GR. OIL SHALE
830			.59						" "
831			.75						" "
832									" "
833			.83						" "
834			.67						" "
835			.67						" " — MM
836			.45						836.5 - 837.1 OIL SHALE SS
837	0		.57						LOW GRADE OIL SHALE
838			.24						838.00' banded LT BRN BUFF
839			.41						to DK BRN Low grade oil shale
840									
841			.27						S.S. Lense LT BRN to BUFF colored
842									DRK banding Med BRN oil shale
843									LT BRN slightly calcareous
844									thinly banding
845			.09						LT BRN BUFF Low to Med grade
846									oil shale
847	-10		.54						DRK BRN Oil shale
848									LT BRN to DRK BRN dist bed
849			.67						" " " oil shale
850			.11						DRK BRN twisted bedding oil shale Med grade
851			.3-.75						DK GRY oil shale slightly
852			.63						LT BRN oil shale calcareous
853			.52						zone (?)
854			.25-.4	.45					
855									Med BROWN twist S.S. oil shale
856			.83						" " oil shale
857	-30								DK BROWN " "

COMMENTS:

HOLE NO: X4 SHEET 5 OF 6 DATE: 1-4-75 LOGGED BY: SUNDSTROM COLLAR: ____ TD: ____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
858								Med BRN - Med grade oil Shale slight
859								" " " " " " " mAL CHERT
860								" " " " " "
861						30 & 30		Lt BRN - Low grad oil shale "
862			.5					" " " " " " "
863		.5	.18			DRILLED		" " " " " " "
864			.25					" " with DK BRN bands - oil shale
865		.01	.3					DRK BRN
866		.7	.35 .7					Med BRN Oil shale
867	-30		.55 .9					866.70 Lt BR to Med oil shale
868		.6	.15 .75					S.S. Lense " " " " "
869			.84					" " " "
870								" " " "
871			.24					Lt br - Low grade oil shale
872								" " " " "
873			.08					Lt br DK BR Layers SS Lenses
874			.45					Low grade " IN
875								" " this
876			.01					" " Area
877	-40							" " "
878			.66					" " "
879			.46					" "
880								Lt br / DK BRN Layers thin, Low grade Shale
881			.08					" " " " " " "
882			0					" " " " " " "
883								" " " " " " "
884								" " " " " " "
885								" SS Lense " " " " " "
886			.5			DRILLED		Lt brn with DRK BRN layers Low grade oil sha
887	-50							" " "
888			.20					" " " "
889			.38					" " " "
890			.15					" " " "
891			.1 .8					" " " "
892			.07 .5					" " " "
893			.27					Lt brn, white coarse Oil Shale
894			.12 .3					" " " "
895			.17 .4					" " "
896								896.70 " "
897	-60		.33 .45					Lt brown coarse Oil Shale
898			.15 .3					" " "
899			.21					" " "
900			.6					Med Grade Oil Shale
901			.5					" "
902			.3					Grade to Low " SS "
903			.5					Lt brn Med BRN Oil Shale
904			.2					Grade Oil Sat: Vein "
905			.13 .31					Med DK BRN Oil BR with Lt BRN
906			.16					Layers "
907	-70		.2					" " "

HOLE NO: X-4 SHEET 6 OF 6 DATE: 1-4-75 LOGGED BY: KANOUS COLLAR: ____ TD: ____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
908			.34					MED BR. MED GR. OIL SHALE WITH
909			.32					DK GR. BANDS. 908.30 OIL SAT.
910			.05 .32					"
911			.28 .35 .48 .36					"
912			.21 .5 .92					"
913			.46 .60 .72					"
914			.36 .2 .40					"
915			.65					MED BR. MED GR. OIL SHALE
916			.19 .2					INT. OIL SHALE & OIL SAT SS
917	-80		.05 .14 .32					" "
918			.15					LT. BROWN LOW GR. OIL SHALE
919			.01 .05					919.55 OIL SAT SS .05 W. OIL
920			.02 .12					LT BR. LOW GR.
921			.14 .2					" "
922			"					LT BR. LOW GR OIL SHALE
923			.13 .20					"
924			.05					"
925			.07					"
926			.3 .7					"
927	-90							926.70 "
928								LT. BR. TO DRK LOW GR. OIL SHALE
929			.36					MED BR BANDS
930			.32					LT. BR., LOW GR. OIL SHALE
931								" "
932								" "
933								
934								934.1 - 934.25 .50 - .70 OIL SAT SS LAYERS
935								LT. GR. LOW GR OIL SHALE
936			.45					LT. TO MED GR. LOW TO MED GR.
937	-100							" "
938								" "
939			.70					" "
940			.44					940.65 TO .80 OIL SAT SS
941			.40					LT. BR. LOW GR. OIL SHALE
942			.92					"
943			.92					"
944								"
945			.13 .20					LT TO MED BRN LOW GR. OIL SHALE
946			.30					OIL SAT. SS AT .80
947	-110							LT. GR. LOW GRADE OIL SHALE
948								" "
949								" "
950			.45					"
951			.65					"
952			.90					VERT FRX. COATED W/ OIL
953								"
954			.2 .6					"
								"
	-120							"

COMMENTS: 1 FT. OIL COATED VERT FRX. 951 & 952 - SMALL CIRCLE AROUND OIL COATED

HOLE NO: [illegible] SHEET 1 OF 2 DATE: 1-[illegible]-85 LOGGED BY: [illegible] COLLAR: [illegible] TD: [illegible]

FROM	TO	±MN	ASSAY 10 20 30 40	GAL/TON	DESCRIPTION
0	[illegible]				OVERBURDEN
[illegible]	[illegible]				NO SAMPLE CUTTINGS MIXED WITH CEMENT
	[illegible]				
	[illegible]				
	[illegible]				
	[illegible]				
	[illegible]				
	[illegible]				
	[illegible]				
	[illegible]				
	[illegible]				
	[illegible]				
	[illegible]				
	[illegible]				
	[illegible]				FN GR LT BRN SILTSTONE WITH GREY SDSTONE
[illegible]	[illegible]				LT GREY SANDSTONE
	[illegible]				" "
	[illegible]				LT BRN SILTSTONE & GREY SANDSTONE
	[illegible]				LT GREY SANDSTONE
	[illegible]				" " " "
	[illegible]				Lt Grey Sandstone
	[illegible]				" " " " & Lt BRN SLTSTONE
	[illegible]				" " " " "
	[illegible]				Lt BRN to Med BRN "
	[illegible]				" " "
[illegible]	[illegible]				" "
	[illegible]				Med BRN to DRK BRN SH
	[illegible]				" " "
	[illegible]				" " "
	[illegible]				DK BRN SH with some Med BRN chips
	[illegible]				" "
	[illegible]				" "
	[illegible]				DK BRN & Med BRN SH with a Few Grey chip
	[illegible]				" " "
	[illegible]				" " "
[illegible]	[illegible]				Lt Grey SS & Lt BRN to DRK BRN SH.
	[illegible]				" " "
	[illegible]				" " "
	[illegible]				Lt BRN to DRK BRN with Some Grey chips
	[illegible]				" " "
	[illegible]				" " "
	[illegible]				" " "
	[illegible]				" " "
	[illegible]				" " "
	[illegible]				Reddish BRN cuttings (Fine - Intermediate grinds)
	[illegible]				BRN to Reddish BRN SH, SS Fine GRIND.
	[illegible]				" " " " "
	[illegible]				" " " " "
	[illegible]				" " " " "
540					[illegible] T.D. Service

HOLE NO: XS SHEET 2 OF 2 DATE: 1-7-75 LOGGED BY: RAMMS COLLAR: ____ TD: ____

FROM	TO	±MM	ASSAY 10 20 30 40	GAL/TON	DESCRIPTION
550	560				RED TO LT BRN SILTSTONE
	570				LT BROWN SHALE WITH MINOR SS
	580				" " "
	590				LT TO MED. BRN SHALE MINOR SS
	600				" " "
	610				MED. BRN SHALE SILTSTONE EFF.
	620				" "
	630				MED TO LT BRN. SILTSTONE "
	640				" " "
	650				MED BRN. SILTSTONE MODERATE EFF. INDR.
	660				" " " "
660	670				" " " "
					END OF CHIP SAMPLING. START CORE DRILLING

NOTE: MISTAKE IN DEPTH OF HOLE. CHIP SAMPLES ENDED @ 650'. LOCATION OF MISTAKE UNKNOWN

HOLE NO: X5 SHEET 1 OF ___ DATE: 7-8-15 LOGGED BY: SUNDBERG COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. % RQD	LITH.	DESCRIPTION
652			.89					TOP 651.4 Lt Grey thinly bedded
653			.25					Lt Grey to Lt BRN " "
654								" " " "
655								" " " "
656			.45 .81 .92					" " " "
657								" " " "
658								Lt BRN with dk brn bedding
659								Lt Grey to Lt BRN thinly bedded
660			.6					" " " Grey SS
661								" " " bands
662								" " "
663			.75					" " "
664								" " " Low Grade
665			.53					Lt BRN - with DRK banding
666			.72					DRK brn to Lt brn & Grey Fine bedding
667			.53					Lt BRN with Grey Lenses SS
668								" " "
669								" " "
670		40°	.42					Lt BRN thinly bedded calcareous
671		.55						" " " "
672			.17			30.50		Lt brn to DRK brn
673			.2 .73			30.25		Lt BRN with some Grey lenses
674			.32 .83					Lt BRN thinly bedded calcareous
675								" " " "
676			.47					" " " "
677			.1			DRILLED Rec'd		Lt Grey to buff
678								Buff to DRK BRN oil shale SS BAND with oil
679								" " SS Lense .5
680			.89					Lt buff with Grey thin bedding
681	+130		.05 .75					" " " "
682								681.65 Lt BRN DK Fine banding
683								slightly calcareous
684								" "
685								" " with
686			.63					" " BAND of SS with oil
687								" "
688			.89					" "
689								Lt BRN (buff) to BRN with bands of oily
690								SS " " " "
691	+120							Lt BRN with DRK BRN bands slightly calcareous
692			.4					DRK BRN SS BANDS with oil
693			.17					Lt to Med BRN Fine bedding
694								" " "
695			.07 .11					" " " slightly calcareous
696			.69					" " "
697			.36					" " "
698								Lt BRN with DRK BRN bedding
699			.28					Lt BRN to Med BRN oil shale
700			.79					" "
701	+10							Med BRN / DRK BRN SS oil saturated

HOLE NO: X5 SHEET 2 OF ___ DATE: 1-8-75 LOGGED BY: SUNDBERG / KLINGER COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
702								Lt brn to Med brn ss oil saturated
703			.5					" " twisted bedding "
704								Drk Br ss (saturated oil) 4-5
705						30.40		Lt brn to Drk brn (banding)
706		4	.64			30.40		" " "
707		4	.45					Lt Brn to Med Brn with fine bedding
708								" " Shale with ss oil layers
709								" " "
710		5	.35			DRILLED Rec'd		Lt brn with Drk Brn banding
711	+80	5						" " "
712			.07 .12 .04					712.05
713			.04					Lt. Gr. Oil Shale with Oil Sat ss .07 T. 60
714			.02					Lt. Tan to Lt. Gr. Mottled Oil Shale
715			.10 .07 .1					Faint bedding marked by Thin ss
716			.36					Banding & Lenses Med Brn
717			.03					"
718			.35					"
719			.33					"
720			.13 .3 .35					.20 - .35 Oil Sat. ss "
721	490							.22 - .30 " " " "
722			.11 .20					Few Drk Brn High Grade Veins
723			.02					"
724			.33					"
725		J- 12	.03 .41 .12			730.4 - 731.4		.22 - .60 Oil Sat. ss "
726			.40			730.4 - 731.4		Lt. Tan to Gr. Med Gr. Oil Shale
727								"
728								.30 Oil Sat ss
729								"
730			.27			742.4 - 743.0		.22 - .42 Oil Sat. ss .42 - .731 High Gr. Drk Brn.
731	+80		.43			742.4 - 743.0		.731 - .50 High Gr. Oil Shale
732								Med Brn Med Gr. Oil Shale
733			.14					Med To Lt. Brn. Oil Shale Med T. Lam
734								"
735			.72					"
736			.30					.52 - .55 ss "
737								"
738								"
739			.30					.55 - .65 ss Oil Sat.
740			.52					740.52 - 742.25 Dark Gray Banded
741	+70		.25					ss.
742			.20 .30					742.25 " 742.80 Lt. ss
743								Med Brn Med Gr. Oil Shale
744			.06					A few Drk Brn Veins
745								"
746			.12					"
747								"
748			.32 .09					"
749								"
750			.04					"
751	+60		.14					"

HOLE NO: XS SHEET 3 OF ___ DATE: 1-8-9-75 LOGGED BY: KLANGES SUNDBERG COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. % RQD	LITH.	DESCRIPTION
752								MED BRN MED GR OIL SHALE
53			.05					"
54								"
55								"
56			.45					"
57			.40					"
58								"
59			.53					MED BRN MED GR OIL SHALE
760			.61					A FEW DK BRN BANDS.
61	+50							"
62			.03					"
63			.35					"
64								"
65			.16					"
66								"
67			.26					"
68			.9					"
69								"
770			.82					"
71	+40		.4 .7					"
72			.55					772.55' "
73			.92					Med BRN, Med GR Oil shale, a few
74								DRK BRN bands, few ss lenses
75			.7					" " "
76			.75					" " "
77								" " "
78			.28 .65					" " "
79			.22 .81					Med BRN, Med GR Oil shale Few DRK
780			MB .11 .63 .49 .85					BRN bands
81	+80		.11 .3 .7					" " "
82			.55					LT BRN, Low GR Oil shale calcareous
83			.17 .83					" " " "
84			0 .66					" " " "
85			.2 .44					LT Gray BRN with FINE DK BRN bedding
86			.08 .69					" "
87			.01 .40 .59					" "
88			.77					" "
89								LT Gray BRN TO LT BRN Low GR shale
790			.95					" " "
91	+20							LT BRN with DRK BRN irreg bedding ss lense
92			.09 .57 .91					" " "
93			.09 .69 .82					" " twisted bedding
94			.3 .69					" "
95			.2				DRILLED 30.5' Reid 29.70	LT BRN, Med GR oil shale DRK BRN Bands
96			.1 .75					" " "
97			.55					" " "
98			.83					Med BRN Med Gred Oil Shale
99			.66					" " with OIL Y Lens ss (MAIN MINE)
800								LT BRN with DRK BRN bands
801	+10							" " "

COMMENTS:

THE CLEVELAND CLIFFS IRON CO. PROJECT:

HOLE NO: X5 SHEET 4 OF ___ DATE: 1-9-75 LOGGED BY: Sundberg COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
802			.25 .43					802.25
803			.05					Med brown Med grade oil shale w/ thin
804								Dk brn bands & ss saturated oil
805			.9					Med brn, Med gr oil sh. / Dk brn bands
806								" "
807								" "
808								" "
809			.78					" "
810			.64					" "
811	0		.5 .8					ATTACH. ATTACHED 811.40-811.90 ss
812			.9					" "
813								Dark Brn Med gr oil shale
814			.65					" "
815								Med brn, Med grade, with dk brn bedding
816			0.88					" "
817			.05 .7					" "
818			.2 .63					" "
819			.11 .55 .85					" "
820			.07 .58					" "
821	-10							" "
822			c				30.50	" "
823			.12				29.70	" "
824			0 .3 .37 .45 .92					" "
825			.22 .5 .6 .75					Med brn with dark Brn bands Light bands
826			.05 .15 .35 .71					" "
827			.1 .37				DRILLED Rec'd	" "
828			.45 .75					" "
829			.6					Dk Brn Med Grade O. Sh.
830			.9					Med brn with ss lenses & dk brn bed
831	-20		.95					" "
832			.11 .45					831.95
833			.05					Med to Dk Brn Oil Shale Med to Hd Gr.
834			.06					Distinct Laminations
835			.10					"
836			.35					"
837			.10 .3					
838			.86					Light ss bands.
839								839.74 Gr. change. Color from Dk
840			.67					Med To Dk Brn Hd Gr Oil Shale
841	-30							Thick ss bands
842								Dk Brn to Med Brn Oil Shale w/ ss lenses & bands
843								"
844								"
845			.06					"
846			.21 .31					Med to Dk Brn Oil Shale Thick ss bands
847			.44					
848								848 - 1" ss band.
849								Dk brn to Dk Gr. Shale
850			.2 .5 .7					
851	-40							"

HOLE NO: X-5 SHEET 2 OF ___ DATE: 1-9-75 LOGGED BY: Kinkaid COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
52			3.5	60				DRK TO BLK BROWN OIL SHALE W/ LT GR
53			.13					THICK BEDDED MARKED BY SS LENSES.
54			.5					"
55			.20					"
56			.52					"
57			.40					"
58			.15 .55					
59			.51					"
60			.55 .4					"
61	-50		.22					"
62								"
63			.50					"
64								863.50 LOST 1.50' CORE
65			.11					LT BROWN LOW GRADE OIL SHALE
66			.12					THINLY LAMIN.
67								.50 & .70 1/2" THICK SS - MED GTT.
68								"
69			.51 .4					LT BRN TO BRN LOW GR. OIL SHALE
70			.45 .44					" "
71	-60		.61					" "
72								
73			.53					
74			.45 .1	12				.92 - 875.30 SS LAM
75								
76			.11					55 - 12 OIL SAT. SS
77			.45					MED BRN MED GR. OIL SHALE
78								DRK BRN MED GR. OIL SHALE
79			.5					" "
80			.2					" "
81	-70		.5					881.50 - 882.36 MED GR SAND
82			.16					.36 THIN OIL SAT. SS.
83								" "
84			.16 .20	.52 .58				LT BRN GRN MED GR OIL SHALE
85			1.1					"
86			.36					MED BRN MED GR. OIL SHALE
87			.5					" "
88			.4 .3					" " THIN
89			.65					889.70 - 890.30 INT. SS & SILTY OIL SHALE
90								SILTY LAMINAE @ 20° TO CORE AXIS
91	-80							MED BRN MED GR OIL SHALE
92			.12					"
93								
94			.52.54					OIL SHALE (Now Graded)
95								Light to medium brown, finely laminated, occasional
96			.74					layers 5 to parts of 1mm thick of light brown
97								layers of dolomitic siltstone.
98			.78					
99								
100								
101	-90							

HOLE NO: X-5 SHEET 6 OF 6 DATE: 10 Jan '75 LOGGED BY: GC CENTRY COLLAR: _____ TD: _____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
902			.20				H	
903							H H H	
904							H	Mod-Grade layers
905								OIL SHALE, low Mod grade, Mod. Rich (905.8-923.2)
906		20 Vert	.20					Missing core 906.20 - .30)
907								High Grade Zone (coring oil)
908		.10						
909			.88					Tuff Ss layer (909.53-.55) w/ black oil shale
910		2 70° NEW ED						Mod-High Grade Beds (layers)
911	-100	100						
912								
913			.28 .63					
914								Nahcolite, as disc. layers in rich oil sh Fm
915			.00 .33					(Disregard this)
916								Slightly-rich oil sh.
917			.04					
918			.09					
919			.05 .25					
920								
921	-110							
922								
923		Vert	.13 .77				H	
924		100	.32 .4			924.30	H	SHALE, (923.20 - TD.) Lt. Brn, thin to finely Silty, lamy, non-calc, Hard, num Hair-like pods.
925							H	
926			.25				H	
927		100	.15				H	
928			.21				H	
929								
930			.45				H H	
931	-120		.77				H	
932			.19				H H H	
933			.72					
934			.82					
935						935.30		
								TD = 935.30'

HOLE NO: X-6 SHEET 1 OF 1 DATE: 1-12-75 LOGGED BY: D. Starbuck COLLAR: ____ TD: ____

FROM	TO	±MM	ASSAY 10 20 30 40	GAL/TON	DESCRIPTION
232	242			*	Dark oil shale
242	252				"
252	262				Dark oil shale with minor silt-sandstone bedding
262	272				" "
272	282				Dark oil shale
282	292				" Started hitting moisture at ~ 289 ft - Low Recovery
292	302				No Recovery
302	312				Dark oil shale
312	322				"
322	332				"
332	342				"
342	352				"
352	360				OIL SHALE, V. Hk. Brn., brittle, slty calc
360	370				do (Brief, low flow of water @ ≈ 369)
370	380			**	do, occ. vfg. mass, V. calc
380	390				do
390	400				SHALE, do, SILTY, V. Calc
400	410				do
410	420				do
420	430				do
430	440				do
440	450				do
450	460				do
460	470				do
470	480				do
480	490				do
490	500				do
500	510				do
	CORE BELOW THIS DEPTH				

No screens to collect samples

(m - 3.28 ft)

HOLE NO: Y-1 SHEET 1 OF 7 DATE: 1/18/15 LOGGED BY: W. Houston COLLAR: ____ TD: ____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
DJS 510								Oil shale - Dark - calcerous
11			.92			510.10		- do -
12			.22					- do -
13			.30					- do -
14			.18	.73				- do - (514.41' - 514.52' non
15			.70					- do - uniform sandstone bed)
16								- do - (515.70' - 515.73' ss)
17			.10					- do -
18			.25	.75				- do -
19			.88					- do - - Light - calcerous
520								Oil shale Dark
21								Oil shale Dark
22			.61					ss w/ dark oil shale beds
23								ss calcerous w/ lt. oil shale
24								- do -
25			.44					- do -
26			.68					- do -
27						530.60'		ss, calcerous w/ dark oil sha
28								ss, calcerous w/ light oil shale ban
29						Recovered 530.52'		- do - (528.50 - 528.55
530			.00	.07	.67			- do - non calc drk ss)
31								- do -
32			.41					
33								
34								
35			.12	.19				ss, calcerous w/ dark oil shale ban
36								- do -
37			.20					- do -
38			.50					- do -
39			.73					ss, calcerous (w/ light oil sha
DJS 540			.63		540.70			- do - in fine bands)
41								- do -
42								
43			.12					OIL SHALE LOW TO MED GRADE
44								CREAM TO MED BROWN SILT
45								SAND LAMERS OIL SATURATED
46								
47								
48			.24					
49			.51					
50								THIN 3 to 5 SAND LAYER OIL SATURATED

HOLE NO: X-6 SHEET 2 OF 7 DATE: 14 JAN '75 / 15 JAN '75 LOGGED BY: EC CENTNER, R. ROBERTSON, D.J. SIMBECK COLLAR: ____ TD: ____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
550			.57					LOW GRADE OIL SHALE
551	+130							
552								
553								
554								
555	556			.6				
	557							557.00-.20 OIL SATURATED SAND LENS
	558							
	559							
	560							
	561	+120						
	562			.20				562.75-.35 OIL SATURATED SAND LAYER
	563							
	564							
	565							
	566			.37				
	567			.37				LOW GRADE SHALE
	568							
	569							
	570			.70				570.05-571.03 SAND LAYER w/ contorted
	571	+110		.03	.78	574.06		571.85 silt lenses 571.73-571.8
	572			.45				discontinuous sand layer
	573		VERTICAL .66	.31				573.31-.35 coarse sand layer, 573.65-57
	574			.05				sand-silt bed w/ vertical healed fractu
	575			.03	.81			
	576			.57				Medium grade oil shale
	577		VERTICAL .02 .46	.10	.48			577.02-.48 coarse grained ss laye
	578			.48				foil saturated & vertical fracture
	579			.48				SHALE, silty, med-dk Brn., (Mod ft) V. Calc
	580			.15, .44				w/ numerous, scattered $CaCO_3$ pisolites; occ py
	581	+100		.35, .59				Hem.; much biotite
	582			.11, .47, .73				SS (Tuffaceous), (582.20-.51), oil impreg., w/ ser
	583			.53				contorted, sh layers. do (583.23-.28)
	584			.28, .81, .98				
	585			.44, .92				
	586			.42				
	587			.89				
	588			.40				pp coated w/ biot. & siderite (?)
	589			.12, .90				
	590			.71				SS (Tuffaceous), (590.02-.21), altered, oil sat.
	591	+90		.96				do (591.48-.91)
	592		.73	.73				
	593		VERT	.66				
	594		.65	.65				
	595			.50				
	596			.08				
	597			.11				
	598		.66	.02				
	599		VERT	.85				SS (Tuffaceous) (599.95-600.00) w/ Calcsinter Blebs

REC. 30.10, RQD 31.11 (Ground up to 1.25" thick 10.30 pm) 1-14-75 D. Stc

HOLE NO: X-6 SHEET 3 OF 7 DATE: 15 JAN '75 LOGGED BY: E.C. GENTZLER COLLAR: ____ TD: ____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
600		Vert.						
601	+80					602.50		3 LOST CORE (601.46 - 602.50)
602								
603								
604								
605								UPPER WAVEY BED (605.9 - 608.
606			.10					Tuff. Ss, highly altered & contorted, silty calc.
607								
608			.03 / 125°	6.77				
609								
610								
611	+70							
612			.95					
613								
614								
615								
616								
617								
618			.17					
619								
620		.55						
621	+60	Vert.						
622		.84						
623								
624			.43					
625								
626								
627		.73	.13					
628		.73	.66					
629								LOST CORE (presumed left on bottom)
630								
631								
632				628.46				SEE NOTE (1)
633								SMALL LOW GRADE OIL SHALE WITH ZONES
634			.33					OF MEDIUM TO HIGH GRADE
635								SHALE - CREAM TO LIGHT BROWN
636								AND SOME SMALL ZONES OF DARK
637			.36					BROWN.
638								
639			.40					
640								RICHER SHALE ZONE
641								
642			.14					
643								
644			.42					
645			.58					
646			.30					
647								
648								RICHER SHALE ZONE
649								
650			.57					

NOTE: ALL DEPTHS ADJUSTED ACCORDINGLY BY WIRE LINE MEASUREMENTS BETWEEN 1/2 FOOTAGE MARKS ON LINE BY 4.3'

SHOWED NO FRACTURES BY UV LIGHT

Thin Sections Taken

HOLE NO: X-6 SHEET 2H OF 7 DATE: 1/15/75 LOGGED BY: _____ COLLAR: _____ TD: _____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION

HOLE NO: X-6 SHEET 1 OF 7 DATE: 1/15/75 LOGGED BY: W. MARTIN COLLAR: TD:

DEPTH	±1M	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
650			.74					
51	+30		.63					
52			.25					SILTSTONE BUFF WITH NUMEROUS PP'S
53			.67					
54								
55			.10					MARLSTONE, LIGHT GRAY, HARD CALCAREOUS
56								
57			.72					
58			.55					
59			.17	50	6.3	1.40	—	
660			.57					
61	+20		.52					25 OIL STAIN 661.52 - 90
62								
63			12.66					
64			20.20	25				
65			.19					SANDSTONE LAYER OIL SATURATED
66			.06					
67			.10 80					
68								
69			.05					
670								
71	+10		.15					
72								
73			.12					
74								LOW GRADE SHALE
75			.33					
76								
77								
78								
79								
680								
681	0							681 FT 681.80 MAHOGANY MARKER
82			.61					SANDSTONE LAYER OIL SATURATED
83								
84			.73					
85								
86			.65					SANDSTONE LAYER OIL SATURATED
87								
88		L.C	.05					HIGHER GRADE SHALE
89			12.70	50	6.1	1.76		
690	-10							

HOLE NO: X-6 SHEET 4B OF 7 DATE: 16 Jan '75 LOGGED BY: EC GENTZLER COLLAR: ____ TD: ____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	CAL/FOOT	REC. & RQD	LITH.	DESCRIPTION
689						99.5		SHALE, lt to med Brn (& BLK-BRN in oil rich zones)
690			.13-.21 .24-.27				T	Silty, finely laminated, ± Calc, ± Dol to
691							T	high grade oil sh zones, occ thin lens of
692			.56				T	dolostone & occ lens of ss (cm. thk) Also
693			.62				T	thin Bentonite layers (Tuffaceous?).
694			.34-.41				T	
695			.21				L	
696			.15-.26					
697			.42					
698			.13-.15				L	
699								

HOLE NO: X-6 SHEET 5 OF 7 DATE: 16 JAN '75 LOGGED BY: E.C. GENTZLER COLLAR: ____ TD: ____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
700							+ x + =	Huntoff's layer (.5') 700.2'
701			.81				+	
702							+	
703							+	
704								
705			.38				+	
706			.37				+	
707							+	
708			.77				+ x + =	Hun (.05') irregular layer of tuff. ss
709			.44				+	
710			.09				+	
711			.22				=	
712							+	
713			.96				+	
714							+	
715			.80				=	
716			.40				+	
717							+	
718			.80				+ =	
719							=	
720			.04 .13					LOW TO MEDIUM GRADE SHALE WITH A FEW SAND LAYERS, AND LENS. CREAM COLORED TO MEDIUM BROWN WITH SULFID MINERALS FOUND IN SANDS.
721			.14					
722			.11					
723								
724								
725			.27					
726								
727								
728								
729								
730			.94					
731			.49					
732								LOW GRADE SHALE BUFF TO LIGHT BROWN
733			.92					
734								
735								
736			.57					
737								
738			.68 .93					
739			.63					
740			.24					
741								
742			.35					
743								
744			.55					743.92 - 744.2' SAND LAYER (OILSATU
745			.19					
746								
747								
748			.38					
749			.19					

DRILLER CHECKED HIS NUMBERS HERE
CUT SHOE — REC 30.22' (0.18' ASSUMED LEFT IN BOTTOM) — ECC
7:25 AM, 16 JAN '75 — 30.47' REC.
30.50' CUT — 720.40

HOLE NO X-6 SHEET 6 OF 7 DATE: 1/16/75 LOGGED BY: W. MORTON COLLAR: ____ TD: ____

DEPTH	%MM	FRX	PP	ASSAY 10 30 70 90	CALI MON	REC. GRAD	LITH.	DESCRIPTION
750			.56	74 80 90				HIGHER GRADE ZONE
51								
52								LOW TO MEDIUM GRADE SHALE
53			.02 .25 .5 .78 .85					WITH ZONES OF HIGH GRADED
54			.22 .55 .05					LIGHT BROWN TO BLACK -
55			.18 .54 .91					INTERBEDDED SS AND SOME
56								SILTSTONES -
57			.03 .38 .75 .49					HIGHER GRADE ZONE INTERBEDDED
58			.13 .3 .77					WITH SAND LAYERS SOME
59			.15					DEAD OIL PRESENT
760								
61			.00 .60					
62			.61 .5					LOW GRADE SHALE
63			.04 .3					
64								
65			.43					
66			.2 .56					
67			.44					
68								
69			.17					
770								
71			.35					
72								
73			.51					
74			.73					7755-77600
75			.64					OIL SATURATED SAND LAYER
76								
77								
78			.60 .53					
79								
780				78.10				
81								
82			.78					LOW TO MEDIUM GRADE
83								SHALE SOME OIL SATURATED
84			.83					SANDY AREAS PRESENT.
85			.36 .33					LIGHT TO MEDIUM BROWN
86			.43 .65 .77					HARD
87			.23					SANDSTONE LAYER OILSATURATED
88								
89			.95					
790								
91			.1					
92			.15					
93			.20 .53					
94								
95								
96			.51					
97			.89					
98								
99			.11					

HOLE NO: X-6 SHEET 7 OF 7 DATE: 1/16/75 LOGGED BY: D STARBUCK (WINDOWMAN) COLLAR: ____ TD: ____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
300			.84					LOW GRADE SHALE
01			.81					
02			.44					
03			.50					
04								
05				@ 5.03'				
06								END HOLE 305.03
07								
08								

HOLE NO: X-9 SHEET 1 OF ___ DATE: 14 DEC '74 LOGGED BY: N.R. EUGRNE COLLAR: ___ TD:

FROM	TO	±MM	ASSAY 10 20 30 40	GAL/TON	DESCRIPTION
0	26				OVERBURDEN
26	30				SANDSTONE LT BRN TO LT GRY SLTLY CALC SOME BIOTITE
30	40				SANDSTONE LT BRN TO LT GRY MOD CALC f-gnd
40	50				SANDSTONE LT GRY SLTLY CALC MED-f.gnd
50	60				SAME AS ABOVE V.f.-gnd
60	70				SANDSTONE LT BRN TO LT GRY MOD CALC, f-gnd.
70	80				SANDSTONE LT BRN TO LT GRY V. CALC, f-gnd.
80	90				SAME AS ABOVE, V.f-gnd
90	100				SANDSTONE LT BRN TO LT GRY SLTLY CALC, f-gnd
100	110				SAME AS ABOVE, Vf-gnd
110	120				SANDSTONE LT GRY SLTLY CALC, f-gnd
120	130				SANDSTONE LT GRY MOD CALC, f-gnd
130	140				SAME AS ABOVE, V.f-gnd
140	150				SANDSTONE LT BRN TO LT GRY SLTLY CALC V.f-gnd
150	160				SAME AS ABOVE V.f-gnd
160	170				SANDSTONE LT BRN TO LT GRY MOD CALC V.f-gnd
170	180				SANDSTONE LT BRN TO LT GRY SLTLY CALC V f-gnd.
180					

HOLE NO. G _ SHEET 1 OF ___ DATE: 1/4/75 _ LOGGED BY: [illegible] COLLAR: ___ TD: ___

FROM	TO	±MM	AIR 10 20 40 80	GAL/TON	DESCRIPTION
170	180				NO SAMPLE. TROMEL CEMENT MIXED
180	190				" " WITH ROCK
190	200				" " " " "
200	210				VERY FINE DUST TYPE MATERIAL
210	220				" LIGHT GRAY TO DK. BROWN
220	230				"
230	240				"
240	250				"
250	260				"
260	270				VERY FINE DUST TYPE MATERIAL
270	280				" DARK BROWN TO REDISH
280	290				" BROWN
290	300				" (WATER FLOW CONTACT BETWEEN SH & SH)
300	310				" DRILLING RATE SLOWED DOWN SHALE?
310	320				"
320	330				"
330	340				NO SAMPLE (MUCH H2O ZONE IS CAUSING CUTTINGS
340	350				" "
350	360				" "
360	370				" "
370	380				" "
380	390				" "
390	400				SAMPLE LIGHT GRAY TO GREEN-RED FRAGMENTS
400	410				" " " " "
410	420				" " " " "
420	430				" " " " "
430	440				" " " " "
440	450				SH - DARK BROWN TO REDISH BROWN
450	460				"
460	470				"
470	480				"
480	490				"
490	500				"
500	510				"
510	520				"
520	530				"
530	540				"
540	550				"
550	560				"
560	570				"
570	580				"
580	590				"
590	600				"
600	610				"
610	620				"
620	630				"
630	640				"
640	650				"
650	660				"
660	670				"

EACH FEW CHIPS AS BIT GRINDS THE MATERIAL TO VERY FINE.

HOLE NO: X9 SHEET 2 OF ___ DATE: 1/5/75 LOGGED BY: L. SUNDBERG COLLAR: ___ TD: ___

FROM	TO	±MM	ASSAY 10 20 30 40	GAL/TON	DESCRIPTION
610	620				SH - DARK BROWN TO REDISH BROWN
620	630				" " "
630	640				" " "
640	650				" " "
660	660				" " "
660	670				" " "
670	680				" " "
680	690				" " "
690	700				SH CHIPS DK BROWN
700	710				" FINE CHIPS DK BRN
710	720				" " " " "
720	730				" " " " "
730	740				" " " " "
740	750				SH DK BRN FEW CHIPS - FINE GRIND
750	760				" " " NO CHIPS - " "
760	770				" " " " " " "
770	780				" " " " " " "
780	790				" " " " " " "
790	800				" " " " " " "

HOLE NO: X-5 SHEET 1 OF ___ DATE: 1/6/75 LOGGED BY: D. MOULTON COLLAR: ___ TD: ___

ADD 16 TO ALL NUMBERS

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
5[illegible]	+[illegible]							OIL SHALE LIGHT TO MEDIUM GRADE
01	—	98	.14					WITH A FEW ZONES OF HIGHER GRADE
02			.00 A1					LIGHT TO MEDIUM BROWN - HG.
03			.07.35					BLACK - SAND LAYERS PRESENT
04			.11					BUT THIN
05			.31					
06			.56					
07	+120							507.0-.2 SAND LAYER WITH SULFIDE MINER
08			.76					
09		98						
510			.36.31					510.3-.8 HIGHER GRADE ZONE BLACK
11			.28					
12								
13								
14								
15								
16								
17	+110		.85					517.35-.5 HIGHER GRADE ZONE DRK. BRN
18								
19								
520								520.4-.55 SAND LAYER
21								
22			.16					522.55-.63 SAND LAYER OIL SATURATED
23								523.17-.37 " "
24								
25								
26			.32					SULFIDE MINERAL 526.80-.26 SAND LAYER ~~OIL SATURATED~~
27	+100							
28								
29			.48		530.28			529.00-.20 SAND LAYER SULFIDE MINER
530								530.65-531.1 " " OIL SATURATED
31								
32								
33								LOW GRADE OIL SHALE
34			.00					
35			.69					
36								
37	+90		1					
38								538.65-.9 SAND LAYER OIL SATURATED
39								
540								540.00-.35 SAND LAYER OIL SATURATED
41								
42								
43								
44								
45			.46					
46								
47	+80							
48			.23					
49		98T	.53					

CUT - 524.0' REC'D 524.25' 1/6/75 W MOULTON

CUT - 537.2' REC'D 537.25' 1/6/75 W MOULTON

HOLE NO: X-91 SHEET 2 OF ___ DATE: 1/7/75 LOGGED BY: W. MCCLEAN COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
50		T96	.9					LOW TO MEDIUM GRADE SHALE
51								
52								
53								
54			.47					
55			.42					
56								
57	+70							5785 - 5791.5 UPPER WAVY BED
58								CONTORTED, OIL SATURATED
59								SAND LAYER
560			.55	36	.53			5853 - 5861.5 HIGHER GRADE ZONE DARK
61								
62								
63			.05					
64								LOW GRADE SHALE HARD + HEAVY
65								
66								
67	+60							
68								
69								
570								
71								
72		10°	.01					
73								
74			.35					
75								
76								
77	+50		.11					
78								LOW TO MEDIUM GRADE SHALE
79								
580								
81								
82			.52					HIGHER GRADE ZONE 582-594
83								
84								
85								
86								
87	+40		.07					MEDIUM GRADE ZONE
88								
89			.33	5903.5				
590								
91								LOW GRADE SHALE WITH SOME
92								← RICHER ZONES - SMALL
93								
94			.76					
95			.11					
96								
97	+30		.05 .30					
98			.30					
99								WHITE UNFILLED MATERIAL

HOLE NO: X--C SHEET 3 OF ___ DATE: 1/7/75 LOGGED BY: W MOLTEN COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
900			.07					
01			26.62					LOW GRADE SHALE
02								
03			.53					
04			.10					
05								
06								
07	+20							907.5-909.5 HIGHER GRADE SHALE
08								
09			.51					909.75-910.1 CREAM COLORED SAND LENS
910								SLIDE STRINGERS PRESENT
11			.06					
12			.25					
13			.1.151					913.11-.51 SAND LAYER OIL SATURATED
14								
15			.32					
16								
17	+10		.13					HIGHER GRADE SHALE
18								
19			.69					
920								
21			.22	921.22				
22			.2					LOW TO MEDIUM GRADE SHALE
23								IN UPPER PART OF RUN - (MAHOGANY
24								ZONE) HIGH GRADE IN MIDDLE
25								AND LOWER PART OF RUN
26			.80	MM->				926.75-927.2 MAHOGANY MARKER
27	0	.00	3.57 .83					NOT TYPICAL - NOTE SATURATED
28			21.50					CREAM COLORED.
29								
930			.09					
31			.24					FHIGHER GRADE ZONE
32								
33			.63					931.2-4 SAND LAYER OIL SATURATED
34								934 START FHIGH GRADE ZONE
35			.75					MAHOGANY ZONE
36			.07					
37	-10		.01					
38			.05 .90					
39			.14.77 .93					
940								
41			40.52 (.93 (CORRECTED)					~~LOW GRADE~~
42								
43			.27					
44								MEDIUM GRADE SHALE
45			.17					
46								
47	-20							
48								946.65-75 SAND LENS
49								

CUT 3 3/8" RUN 2 FROM 1/7/75 4:00 PM VOLUMETRIC

CUT 3 3/8" RUN 3 FROM 1/7/75 9:00 PM VOLUMETRIC

4. ORIENTED DRILLER'S DEPTH AT 2452 FT. IS 2,11' - SAW FROM (CAMERA RUN 6)

HOLE NO: X-C1 SHEET 1 OF ___ LOGGED BY: W. MOULTON DATE: 1/8/75 COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC & RQD	LITH.	DESCRIPTION
950							X	LOWGRADE
51				9500			X	" "
52								952 - 956 HIGH GRADE ZONE
53								DK BRN TO BLACK
54								
55								
56								LOW TO MEDIUM GRADE
57	-30							
58								
59								
960			.73					960 - 962 HIGHER GRADE ZONE
61			.96					BANDED DK BRN TO BLACK
62								
63			.58					LOW TO MEDIUM GRADE
64			.60					
65			.22 IBR					
66								
67	-40							
68								
69								
970			.26					
71								
72								
73			.91					
74								
75								
76			.7					LOW GRADE SHALE
77	-50							
78								
79								
980			.7					
81								
82								PEBBLE ? (BREAKS MECH.)
83				9830				
84			13.34					
85								
86			57.85				HH+	986.7 - .92 SHALE LAYER OIL SATURATED
87	-60	IBR	.30					987.3 - 989 HIGH GRADE ZONE
88								DK BRN TO BLACK
89								
990								LOW GRADE SHALE
91								CREAM COLORED TO LIGHT BROWN
92			.13 IBR					
93								
94			.16					
95			.51					
96			.12 AS					
97	-70		.00 .22 IBR .73					
98			.36					
99								

HOLE NO: X-6 SHEET 2 OF ___ DATE: 1/9/75 LOGGED BY: W. MOLTER COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
1000			106.71					LOW GRADE SHALE
01			37.77				FFF	CREAM COLORED TO LIGHT BROWN
02			32.5					1001.37 - 1002.90 SAND LAYER - INNER
03			3.5					BEDDED SHALE
04								
05			.31					
06			.6					
07	-80							
08			.65					LOW GRADE SHALE
09								CREAM COLORED TO
1010			.36					LIGHT BROWN
11								
12				(1013.83)				
13			.33	1013.53				(LAST .50' FOOT BOTTOM OF HOLE)
14								
15								LOW GRADE SHALE WITH ZONES
16								OF OOZING DEAD OIL STAIN
17	-90							IN SAND LAYERS - THINLY
18			.5					BEDDED
19								
1020								
21								
22			.57					1022 - 1025,
23			.71					
24			.25					1023 - 1025 OOZING OIL ZONES
25								
26								
27	-100							
28								LOW GRADE SHALE
29			.53					
1030			37.85					1030.37 - 50 SAND LAYER OIL
31								SATURATED
32								
33								
34								
35								LOW GRADE SHALE
36								
37	-110							
38								
39			.77					
1040								
41								
42			58.91					
43			42.45	1043.33				
44								LOW GRADE SHALE WITH ZONES
45			29.7 .67					OF MEDIUM TO HIGH GRADE
46			42.62					CREAM COLOR TO DARK BROWN
47	-120							TO BLACK.
48			.31					
49			.1					HIGHER GRADE ZONE

REC 30.20

RQD 30.20

RQD 847'

HOLE NO: X-9 SHEET 6 OF ___ DATE: 10/75 LOGGED BY: W. MOULTON COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
1050			AZ					
1051								LOW GRADE SHALE
1052	-R5			1052.00				
		END HOLE						

HOLE NO: X-10 SHEET 1 OF 2 DATE: 12/19/79 LOGGED BY: NHB COLLAR: 5495 TD: 840 approx. — plugge

FROM	TO	±MM	AZIMUTH 10 20 30 40	GAL/TON	DESCRIPTION
0	6				Overburden
6	10				Silty sandstone, light brown, wk-med effer., fine black sp
10	20				Sandstone, lt brn, s. v. slow, lt brn to green, few thin lignite wisps to
20	30				Ss, lt - dk brn; silty ss & siltstone, lt brown; minor sh, wkly effer
30	90				Ss & siltstone, lt - med brown, wkly effervescent
90	50				Silty ss & shale, a. d. grey to minor lt brn, moderately effer
50	60				Ss & silt, lt - med brn & grey, mod effer., pyrite flecks
60	70				Sandstone, lt brn - lt grey, wk - mod effer., fine blk flecks
70	80				Sandstone, lt - med grey, occ - wk effer., fine black flecks
80	90				Ss & siltstone, lt grey - lt brn, some dk grey, wk - mod effer
90	100				Sandstone, lt - med grey, minor lt - dk brn, some wk effer
100	110				Ss, lt grey, minor lt brn., non-calc., minor cathedral py
110	120				Siltstone, lt. grey, minor lt grey ss, non-calc.
120	130				Ss, lt grey, fine gr., non calcareous.
130	190				Ss, lt grey, minor lt brn, non-calc., very fine gr
190	150				As above
150	160				Ss & siltstone, lt - med grey, wk - mod calc, minor lt brn s
160	170				Ss, lt - med. grey, non - mod. calc., fine grained
170	180				Siltstone, lt - med grey, non - wk. calcareous
180	190				Ss, med. grey, v. fine gr., non - calc.
190	200				Ss & siltstone, med. grey, some wkly. calc, ss v fg
200	210				Ss, lt - med. grey, & siltstone, brn-grey, lather mod calc, ss v
210	220				Ss, lt - med grey, v f gr, some siltstone, grey-brn, minor wk calc
220	230				Ss, lt grey, med grey silt, non - wk. calc, minor lt brn ss f
230	240				Siltstone, lt. grey, wkly. calc.
240	250				Siltstone & ss, lt grey, non - wkly calcareous.
250	260				As above, ss v f. gr, few small spherical cavities
260	270				Siltstone, lt grey, non - wkly calc. lt brn. spotting
270	280				Ss, v. f. gr & siltstone lt - med grey, minor lt brown, v. wtl. finely
280	290				Ss & siltstone, ss. v. f. gr, lt grey - grey brn, lt grey shale, non-cal
290	300				Ss, v. f. grey, med. grey, mod calc.
300	310				As above
310	320				As above. Moisture @ 315, very slight
320	330				Ss as above, non - calcareous
330	340				Sandstone, v. fine grained, med. grey, non - calc.
340	350				Ss, v. f. gr., grey - brown, non - wkly calc.
350	360				As above
360	370				Silty ss, lt brn - grey, non - calcareous
370	380				As above
380	390				Silty ss, lt. brn - grey, wkly. calcareous
390	400				Ss, grey-brn - grey-green, v f gr & lt - med brn. sh, calc, lather m
400	410				Siltstone, lt brn, med. calc., minor ss as above
410	420				Shale, lt. - med brown, non - calcareous
420	430				Sh, lt - dk brn & lt grey - green grey, non - calc.
430	440				Sh, lt - dk brn & lt grey siltstone, lather and - stringy ca
440	450				As above
450	460				As above
460	470				Sh, lt brn - lt grey-brn, non - calcareous
470	480				Shale brown to grey - brown, non - calcareous

HOLE NO: X-10 SHEET 2 OF 2 DATE: 12/20/79 LOGGED BY: NHB COLLAR: 5095 TD: 890 approx plunge

FROM	TO	±MM	ASSAY 10 20 30 40	GAL/TON	DESCRIPTION
480	490				Shale dk. brn., some lt. gry-green gray silt, strongly ca
490	500				Sh, lt.-med brn, & siltstone, green-grey, with small; [illegible]
500	510				Sh, lt.-dk brn & light grey, minor lt. grey silt, non-calc
510	520				Sh, dk brn & lt. gray siltstone spheroids, non-calc.
520	530				Sh, dk brn, minor lt gray siltstone, wkly calcareous
530	540				As above
540	550				Sh, dk brn, & siltstone, lt. grey, lather porous & wk-mod calc
550	560				Sh, dk-lt. brn, minor siltstone, lt. gray, slightly calc
560	570				Sh., dk brn, lesser siltstone, lt. grey to gray grn., mod. c
570	580				Sh, lt-dk brn, & siltstone, lt. grey, strongly calc
580	590				Sh, lt-dk brn, strongly calc. (marlstone (?)
590	600				Sh, mainly dk. brn, but variegated from white to lt. grn. & pink. Calcar
600	610				Sh, lt-dk brn, lesser siltstone, lt. gray, non-slightly calc
610	620				Sh, lt-dk brn, & siltstone, v. lt. brn, non calcareous.
620	630				As above
630	640				As above
640	650				Sh, brn-blk, ss, v. f gr., light grey, non-calcareous
650	660				Sh, med-dk brn, w some siltstone, lt. gry, non-cal
660	670				Sh, lt-dk brn, & siltstone, lt. grey, spheroidal ca..., mod calc
670	680				Sh, as above, w minor siltstone, as above
680	690				Sh, lt.-dk brn, slightly calcareous
690	700				Sh, as above
700	710				Sh, dk brn., mod. calc., some ss & silt, yellow-brown
710	720				Sh, lt-dk brn, some gray-grn, + silt, yellow-brn, mod. calc
720	730				Shale, as above
730	740				Shale, dk. brn to brn-gray, slightly calcareous
740	750				Shale, dk brown, minor lt brn, mod. - strongly calc.
750	760				Shale, as above
760	770				Shale, as above
770	780				Shale, as above, + minor ss, reddish-brn w micaceous
780	790				Sh, lt.-dk brn., & Siltstone, green-gray, strongly calcareous
790	800				Sh, dk brn., some green-grey siltstone, calcareous
800	810				Sh, dk brn with lt brown interbeds, very fine minor lt gry silt
810	820				Sh, as above, mod to strongly calcareous
820	830				Sh as above
830	840				Sh as above, wkly to mod. calc.
840					START CORING

HOLE NO: X-10 SHEET 1 OF ___ DATE: 12/29/70 LOGGED BY: MORTON COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
9A0								OIL SHALE - DEK BEIGE BLACK
9A1								MEDIUM TO HIGH GRADE WITH
9A2								ZONES OF LOW GRADE
9A3			.37					
9A4			.14.75					
9A5			.10 .18					
9A6	+130		.61					HIGH GRADE SHALE ZONE
9A7			.10					
9A8			.11					
9A9			.7					
9B0			.2					
9B1		90°	.85 .90					
9B2								LOW TO MEDIUM GRADE
9B3		57	.77.05					SHALE
9B4								
9B5			.5					
9B6	+120		.55					
9B7			.30					HIGH GRADE SHALE ZONE
9B8			.61 .58					
9B9		L 90°	.75					HIGH GRADE SHALE ZONE
9C0			.65 .45					
9C1			.35					
9C2			.00 .4					LOW TO MEDIUM GRADE
9C3	MM	L 90°	.00 .46					
9C4								
9C5								
9C6	+110							6.65 - 6.93 SANDY LAYER OIL
9C7			.87					SATURATED
9C8								
9C9			.53					
9D0								
9D1								BADLY BROKEN AREA MED. H.
9D2								MODERATE GRADE SHALE
9D3			.4					
9D4			.95					9D4.6-9D4.8 SANDY LAYER OIL SATUR
9D5			.73					
9D6	+100							9D6.6-9D7.25 SANDY LAYER OIL SATUR.
9D7								
9D8			0					LOW GRADE SHALE
9D9								
9E0			.1044.					9E0.00-9E0.18 & SANDY LAYER OIL SATU
9E1								
9E2								LOW TO MODIUM GRADE SHALE
9E3			.07					
9E4			.4					9E4.4-9E SANDY LAYER OIL SATUR
9E5			.82					
9E6	+90							
9E7			.61					LOW GRADE SHALE
9E8								
9E9								

BREEDS EXTENSIVELY BROKED DUE TO EXCESSIVE ROUNDING
THE BARREL WITH A CRACKLE HAMMER.

HOLE NO: X-10 SHEET 2 OF ___ DATE: 12/22/24 LOGGED BY: (W Norton) COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
510			.00					LOW TO MEDIUM GRADE SHALE
511			.5					
512			.00					
513			.80				FINE	513A6-.8 SANDY LAMER OIL SATUR
514								
515								
516	+50						FINE	516.6-.9 SANDY LAMER OIL SATUR.
517			10, 50					517.1-.2 " " " "
518								
519								

HOLE NO: X-10 SHEET 3 OF ___ DATE: 12/22/74 LOGGED BY: W. Moulton COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
900								LOW TO MED GRADE SHALE
901								901.38 - .53 SANDY LAYER OIL SAT. OR.
902			.65			902 5ft		
903								
904								
905								LO GRADE, GREEN TO LIGHT BRN SHALE
906	+70							
907			AA					
908								
909								909-910.0 SANDY LAYER OIL SATURATED
910			.50					910.65-912.90 'UPPER WALL' RED
911								MOTTLED SANDSTONE, CONTACTS ERR
912								TAN-RED BRN w LIMONITE STAIN; MOD UNDULATE
913						20 of 20		UPPER & LOWER CONTACTS
914			.30 .76					912.95 - 914 OIL SHALE, GY-DK GY, FIN LAM w thin
915								thin, lens-like stringers of darker material (pyrite
916	+60							
917								
918			.70					
919			.21 .46					LOW TO MEDIUM GRADE SHALE
920								WITH THIN BANDS OF DARKER
921						20 of 20		MATERIAL
922			.65					
923								
924								
925								
926	+50							
927								
928								
929								
930								
931								
932						933 16		
933			.16					MEDIUM GRADE SHALE WITH AREAS
934			.21					OF HIGH GRADE - SOME NAHCOLITE
935								IN VUGS AND LAYERS
936	+40							
937								
938								
939			.55					
940								LOW TO MEDIUM GRADE WITH AREAS
941								OR BEDS THAT ARE PITTED
942			.23					BANDED AREA
943								
944		X-ZONE						
945			E3.71					
946	+30		.72					947 - RED MARLSTONE, buff-light gray with a few
947			.71 .93					~~BUFF-LIGHT GRAY~~
948			.28					947.6 } with small nearly white
949			.16					948.1 }

HOLE NO: X-10 SHEET 4 OF ___ DATE: 12/3-/74 LOGGED BY: WJ MOULTON COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
950			.21 .83					GRADING INTO A ~~SAND~~ RICHER
951			.41					LOOKING SHALE ZONE - MEDIUM
952								GRADE
953								
954								
955								
956	+20							
957			.41					
958			.45					
959								
960			.17 .52				+++	
961			.85				+++	961 SANDY LAYER OIL SATURATED
962			.25					961.55-962.25 SANDY LAYER OIL SATURATED
963			.30 .73					AREA BADLY FRACTURED (MECH)
964								
965								OIL SHALE LOW TO MEDIUM GRADE
966	+10		.33					WITH BANDS OF HIGH GRADE
967								TEAN TO DARK BROWN WITH
968								BANDS OF BLACK COLORED SHALE
969								SOME NARROW SAND LAYERS AND
970			.00					LENSES
971								
972								LOW GRADE SHALE
973			.01					
974								
975			.01					975.1 - 976.4 MAHOGANY MARKER
976	0		.53					SANDY OIL SATURATED LAYER
977			.66					
978								
979								LOW GRADE SHALE
980			.00					
981			.27 .57					
982			.A .SA	92 .85				
983								983-985 MEDIUM TO HIGH GRADE
984								ZONE
985			.00					
986	-10							985 - 990 MEDIUM GRADE
987								ZONE - SOME INNER
988								BEDDED HIGH GRADE
989								
990								
991								990-994 HIGH GRADE ZONE.
992			.A .21 .77					MAHOGANY ZONE ?
993			.01 .51	86				OIL SHALE
994			.21 .AC	82				MEDIUM TO HIGH GRADE SHALE
995			.00					DARK BRN TO BLACK - SANDY
996	-20							LAYERS FOUND IN SOME AREAS
997								OIL SATURATED
998								
999								

HOLE NO: X-10 SHEET 5 OF ___ DATE: 12/31/74 LOGGED BY: W. NOULTON COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
1000		FILL						
1001		10.66	13					1001.6 - 1004 HIGH GRADE ZONE (BLACK)
1002		36.52	72					
1003		40						1003.00 - 1003.52 SECTION OF ZONE 3 TO ZON OIL BANDED HIGH GRADE
1004								LOW TO MEDIUM GRADE SHALE
1005								
1006	-30	65						
1007		510						
1008								
1009								1009 - 1012 MEDIUM TO HIGH GRADE
1010								SHALE
1011		52						
1012								
1013								LOW GRADE SHALE
1014		30						
1015								
1016	-40							
1017								
1018								(LOW TO MEDIUM GRADE SHALE
1019								W/SOME NAHCOLITE LAYERS
1020		41						TOWARDS THE BOTTOM.
1021								
1022								
1023								
1024		35						OIL SHALE LOW TO MEDIUM
1025								GRADE WITH LAYERS OF
1026	-50							HIGH GRADE - CREAM TO
1027		36						DARK BROWN SOME BLACK ZONES
1028								SAND OIL SATURATED LAYERS
1029			15,55					PRESENT ALONG WITH PITTED
1030			15,36	91				AREAS IN SHALE - LEACHED
1031			16,58					SULFIDES
1032			23,91					
1033			176					1033 - 1034 HIGHER GRADE ZONE
1034			77					
1035		126	10,31					1035.25 - .60 SAND LAYER OIL SATURATED
1036	-60		85					185 PP IRR. IN SAND LAYER
1037			12					
1038			59					
1039								LOW GRADE SHALE
1040								
1041			31					
1042			13					
1043			54					
1044			40					LOW GRADE SHALE
1045			02 60					
1046	-70							
1047			47					
1048			74					1048.40 - 1049.77 SANDY LAYER
1049								CONTORTED SOME OIL

HOLE NO: X-16 SHEET 2 OF ___ DATE: 12/31 | 1/1/75 LOGGED BY: W MOULTON COLLAR: ____ TD: ____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
1050			.23					
1051								LOW GRADE OIL SHALE
1052								
1053			.22					
1054			.41					
1055								LOW GRADE OIL SHALE WITH
1056	-90							OIL SATURATED SAND LAYERS
1057			.24					SOME HIGHER GRADE BANDS
1058								ARE VISIBLE
1059			.05					
1060								
1061								
1062								
1063			.71					
1064			.40					LAYER
1065								1064.32 - .54 SANDSTONE OIL SATURATED
1066	-90							SILLS DES PRESENT
1067			.43					BANDS OF HIGH GRADE
1068			.08					1068 - 1072 OIL SATURATED AREA
1069			.62, .96					1069.62 - .96 SAND LAYER OOZING OIL
1070								
1071								
1072								
1073			.10					
1074								
1075		90						1075.00 - 1080.00 OIL OOZING BANDS
1076	-100		.10, .52, .61, .72					FOUND IN THIS RUN
1077								VERY SATURATED
1078								
1079								
1080		1081.3	.90					
1081								
1082		90						LOW GRADE SHALE
1083								
1084								
1085			.86					HIGHER GRADE ZONE
1086	-110							
1087								
1088			.40, .55, .52					
1089			.17, .40					LOW GRADE SHALE
1090			.83					
1091			.25					
1092								
1093								
1094								
1095			.15					
1096	-120							
1097			.60					BOTTOM OF HOLE (1097.60)
1098								
1099								

HOLE NO: X-11 SHEET 1 OF 2 DATE: 14 DEC '74 LOGGED BY: N. BJORNE COLLAR: ..... TD: 1023
15 DEC '74 E. GENTZLER

FROM	TO	±MM	ASSAY 10 20 30 40	GAL/TON	DESCRIPTION
0	28				OVERBURDEN
28	40			E C G	SILTSTONE, lt Brn, V. Calc, occ Biotite & Musc.
40	50				SILTSTONE, ditto
50	60				SANDSTONE, lt Brn to lt Gry, f to v.f-gnd, hard, V. Calc, Much Prot- Much V.f calc. py.
60	70				SANDSTONE, do
70	80				SANDSTONE, do, only slty Calc.
80	90			N R B	SS LT GRY NON CALC BIOTITE FLECKS
90	100				SAME AS ABOVE
100	110				SS LT GRY NON CALC, WITH SOME SILT LT BRN Mod to V. Calc
110	120				SAME AS ABOVE
120	130				SS LT GRY NON CALC
130	140				SS LT GRY NON CALC BIOTITE FLECKS
140	150				S.S. LT GRY SLTY CALC
150	160				S.S. LT GRY SLTY TO MOD CALC
160	170				S.S LT BR TO LT GRY MOD TO V. CALC
170	180				SS. LT GRY WITH LT BR SILTSTONE V CALC
180	190				SS LT GRY SOME SILTSTONE LT BR. MOD TO V CALC
190	200				S'S LT GRY. NON CALC
200	210				S.S. LT GRY TO BRN MOD TO V CALC BIOTITE FLECKS
210	220				SILTSTONE LT GRY. SLTY TO MOD CALC
220	230				SILTSTONE LT BR MOD TO V. CALC Biotite and Pyrite flecks
230	240				SILTSTONE LT BR TO BR. SLTY CALC
240	250				SILTSTONE LT BR TO BR NON CALC.
250	260				SILTSTONE LT GRY TO GRY NON CALC BIOTITE FLECKS
260	270				SILTSTONE LT GRY TO GRY, NON CALC
270	280			E C G	SILTSTONE, Med Brn-Gry, slty Calc, minor Biot; V. hard
280	290				SILTSTONE, lt Brn, slty Calc.
290	300				SILTSTONE, lt Gry-Brn, Sandy (V.f-gnd), Much Biot; friable
300	310				SILTSTONE, do
310	320				SILTSTONE, lt-med Brn, Sandy (V.f-gnd), minor Biot, V hard, V. Calc.
320	330				SILTSTONE, lt-med Brn, Sandy (V.f-gnd), minor Mu c., Soft.
330	340				SILTSTONE, med-lt Brn, V. hard, V. Calc, Minor f. Musc & Biot.
340	350				SILTSTONE, do
350	360				SILTSTONE, do
360	370				SILTSTONE, med-lt Brn, V. hard, V. Calc.
370	380				SILTSTONE, dk Brn, V. hard, V. Calc
380	390				SILTSTONE, med. Brn, V. hard, V. Calc., minor Musc.
390	400				SILTSTONE, do
400	410				SHALE, Med Brn, V. hard, V. Calc
410	420				SHALE, Med-dk Brn, V. hard, V. Calc, w/ Minor V.f. Musc
420	430				SHALE, do
430	440				SILTSTONE, dk Brn, V. hard, V. Calc.
440	450				SILTSTONE, do.
450	460				SHALE & MARLSTONE, dk Brn, V hard, V Calc, minor Musc / lt Gry-Brn, dirty, Calc
460	470				MARLSTONE, lt Brn, silty, V. Calc, hard
470	480				SHALE, Med-dk Brn, V. hard, Mod-V. Calc
480	490			N R B	SHALE, MED-DK BRN V. HARD MOD CALC
490	500				SHALE, DK BRN - V HARD MOD. CALC.

4" CASING SET TO 80'

DEPTH MEASURED FROM TOP OF ROTARY TABLE - 7 FEET ABOVE GROUND LEVEL
WHICH IS 14.6 FEET ABOVE M.S.L.

HOLE NO: X-11 SHEET 2 OF 2 DATE: 12/18/79 LOGGED BY: N. Bjorne E GENTZLER COLLAR: ____ TD: 1025

FROM	TO	±MM	ASSAY 10 20 30 40	GAL/TON	DESCRIPTION
500	510				SHALE MED BRN TO DK BRN. V HARD. NON CALC
510	520				SHALE, MED BRN TO DK BRN V HARD. SLTY CALC
520	530				SHALE MED BRN TO DK BRN HARD MOD CALC
530	540				SHALE LT BRN TO MOD BRN V HARD MOD TO V CALC
540	550				SHALE LT BRN TO BRN MOD TO V CALC
550	560				SHALE DK BRN V HARD V CALC.
560	570				SHALE DK BRN V HARD V CALC.
570	580				SHALE LT BRN TO BRN V HARD, V. CALC
580	590				SHALE MED BRN TO DK BR. V HARD. V. CALC
590	600				SHALE DK BRN V HARD V. CALC.
600	610				SHALE BR TO DK BR. V CALC
610	620				SAME AS ABOVE
620	630				SHALE BRN V HARD V CALC
630	640			NRB ECG	SHALE DK BRN, WITH SOME LT GRY. V CALC.
640	650				SHALE LT BRN TO BRN V. CALC
650	660				SHALE, dk Brn, silty, V. hard, V. Calc, fissile to platy
660	670				SHALE, do.
670	680				SHALE, do.
680	690				SHALE, do.
— CORE BELOW THIS DEPTH —					

HOLE NO: X-11 SHEET 1 OF 6 DATE: 12/19/74 LOGGED BY: W. MALTON COLLAR: ____ TD: ____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION

HOLE NO: X-11 SHEET 2 OF 13 DATE: 12/20/74 LOGGED BY: W Moulton COLLAR: _____ TD: _____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
700								
701		.00						
702								SULFIDE FLAKES
703								
704		.50						
705		.86						
706		.77						OIL RICH SAND LAYER
707		.16 .68						
708		.68						DARKER ZONE RICHER OIL SHALE
709								" " " "
710		.63 .49						
711		.53						
712						CUT 300', RQD 30.32' 11 MINUTES 12/19/74		
713		.25 .65						
714		.74						
715		.35						RICHER ZONE 5.1' W/SULFIDE FLAKES
716		.88						
717								
718								
719		.26 .56						
720								
721		.68				721.58		
722								OIL SHALE MEDIUM TO DARK BROWN WITH SOME BLACK ZONES - ~~FRACTURED~~ LOOSE
723								
724								
725		.50						RICH IN GILSONITE - SULFIDE FLAKES SEEN IN MOST AREAS. A FEW SANDSTONE LAYERS W/ BITUMEN?
726	+80							
727								
728								
729								721.88 - 722.24 BLACK SHALE ZONE
730								728-729 DARK SHALE ZONE
731		.39						
732						LOST CORE AT BOTTOM OF HOLE		
733								~~734.60 - 734.68 SANDSTONE~~
734						734.38		734.60 - 734.68 SANDSTONE
735								735.0 - 735.60 DARKER ZONE, RICH OIL SHALE
736	+130							
737								
738								
739								
740						CUT 223.66		
741						2017 MINUTES		
742		.60				12/20/74		742.66 - 742.84, SANDSTONE IMPREGNATED WITH BITUMEN
743		.31						
744								
745						745.16		745.16 END OF CORE
746	+120							LOST CORE FROM 745.16' TO 752.50
747								TOTAL OF 7.34'
748								ACTUAL CORE LOSS 745.16 - 751.28
749								TOTAL 6.12'

CAVED LOSS RECOVERY 1.15

HOLE NO: Y-11 SHEET 3 OF 8 DATE: 12/20/74 LOGGED BY: N.B. + JM COLLAR: _____ TD: _____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. &RQD	LITH.	DESCRIPTION
750								
751						751.78		CORE BEGINS AT 751.78
752						START CORE 12.15 spm 12/20/74		751.78 - 753.65 TUFF SANDSTONE MOD CAL
753			.95					753.65 - 754.0 OIL SHALE
754								754.0 - 756.25 TUFF SAND STONE MOD CAL
755			.15					
756	+110		.25					756.25 - 756.84 OIL SHALE MED TO
757								DK - BRN, 756.84 - 756.91 S.S. IMPREGN
758			.32					WITH BITUMEN. OIL SHALE 756.91 - 757
759								757.0 - 757.1 S.S DK BRN
760								757.1 - 758.48 OIL SHALE
761								758.48 - 758.68 S.S.
762			762.0					758.68 - 758.89 OIL SHALE
763								758.89 - 759.05 S.S.
764								OIL - SHALE MED TO DK BRN
765						29.5% CUT / 24.22 RECOV 1200-1400		761.71 - 761.86. S.S DK BRN
766	+100		.95					764.76 - 764.82 SS
767								766.13 - 766.95 .S.S DK BRN SULFIDE
768								FLECKS
769			.72					
770								
771								
772			.30					
773								
774			.78					774.39 - 774.60 TUFF SANDSTONE BRN
775								775.83 - 776.14 " " "
776	+90		.91					
777								
778								SHALE V. CALC
779								779.38 - 779.45 S.S.
780			.39					779.60 - 779.66 SS
781		I 90°			781.0	START CORE 6.0 spm 12/20/74		
782								OIL SHALE - LIGHT TO MEDIUM BROWN
783								LOW TO MEDIUM GRADE - VERY HARD -
784								CALC. WITH LAYERS OF SS -
785			.30			100%		784.0 - .1 SS LAYER
786	+80							
787								
788								
789								LOW GRADE OIL SHALE
790			.33					
791								
792								792.55 - 793.03 SANDSTONE UNIT W/ MICROCLITE
793								793.38 - 793.72 OIL SHALE
794			.86					
795						29.5% CUT / 24.22 RECOV 1200-1400		CONTORTED SAND LAYER
796	+70							
797			.10					
798								LOW GRADE OIL SHALE

HOLE NO: X-11 SHEET 4 OF 5 DATE: 12/21/77 LOGGED BY: G. NOLTON COLLAR: _____ TD: _____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
800								
801								OIL SHALE - LONGGRADE MEDIUM GRAY
802								WITH SOME DARKER, VERY THIN BANDS, MOD
803								VERY THINLY BANDED, HARD, CAL
804								
805								
806	+60		.68					
807								
808								
809								
810								RICHER ZONE
811	90°	.20						OIL SHALE, dark brown, sl. - med calc.
812								OIL SHALE - MEDIUM TO DARK
813								BROWN - SOME BLACK -
814								
815								BANDED, CAL-C.
816	+50							
817								MEDIUM GRADE OIL SHALE
818								
819								819-820
820								OIL SHALE - DARK BROWN TO BLACK
821								
822								
823								OILSHALE MEDIUM GRADE?
824								
825								
826	+10							OILSHALE DARK BRN TO BLACK
827								RICH ZONE
828								826.8-824.0 OILSHALE, gray-light brown, finely
829								laminated, carbonaceous - burns
830								OILSHALE DARK BRN TO BLACK
831								RICH ZONE
832								SULFIDE LAYERS
833								LOW GRADE OIL SHALE WITH IMMERSED
834								LAYERS OF NAHCOLITE (NO)
835								" " " " "
836	+30							
837								837.0 - 3" DIC FILLED WITH NAHCOLITE (NO
838								OILSHALE LOW TO MEDIUM GRADE
839								
840								
841								
842								Oil-Shale - Light to Dark
843								Brown - Some very dark
844								Brown to Black Highly Calc
845			31.32					Zones Lenses of Nahcolite
846	+20							Lenses of Dolomite
847			31.00					Low grade to 844.85 Medium
848								grade to 846.33, Rich zone
849								

HOLE NO: X-11 SHEET 5 OF 8 DATE: 12/21/11 LOGGED BY: D. BUCK N. BICKLE COLLAR: ____ TD: ____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	CAL/TON	REC. & RQD	LITH.	DESCRIPTION
850			849.91					849.42 BICKLE 849.61-.66 DARK BROWN BB2.83-850.11 BICKLE
851								850.85 THREE HIGH GRADE BANDS OOZING BITUMEN
852						29.42'		851.71
853			852.45					MEDIUM GRADE ?
854								
855								854.75
856	-10					RECOVERED 100%		855.63 - 855.87 TUFFACEOUS SS. BANDS & LENSES
857								856.18 - 856.93 - 856.66 TUFF. SS MEDIUM GRADE
858								857.55
859								
860			864.60					
861						29.69' RQD		LOW GRADE OIL SHALE
862								
863								
864								
865						CUT		
866	0		866.82					865.57 MAHOGANY MARKER 866.03
867								VERY HIGH GRADE - OOZING
868			867.04 867.67					MUCH DARK BROWN BITUMEN LOW GRADE
869								INCREASING IN GRADE
870								AROUND 867
871			870.90			871.12		870.70 MAHOGANY ZONE 870.93 TUFFACEOUS SS BANDS
872								RELATIVELY HIGHER GRADE
873								872.95 OIL SHALE - GIANT
874			873.65			START CORE 1/3/12		TO DARK BROWN COLOR
875			875.30					HIGHER GRADE SECTION
876	-10		875.87 876.35					INTERMITTENT THIN SS LENS
877								MEDIUM HIGHER GRADE
878								877.83 - 877.91 SS OOZING
879								
880			879.65					880.00
881		15°	880.85			80.27' 94%		880.24 HIGHER GRADE 880.60 LOST CORE
882			881.47 881.95					HIGHER GRADE TO 882.66 ONLY
883								882.66 ← * DISREGARD N.G. 882.66-883 883.00
884						85.94		883.97 LOST CORE 884.35 ← BROKEN CORE
885								
886	-20					RECOVERED 76.98 = 95.62%		HIGHER GRADE
887			886.70 887.20					
888								888.04
889								
890			889.53			31.70' RQD 1.5		MEDIUM GRADE
891			890.7					890.7 891.03 HIGHER GRADE
892								MEDIUM GRADE
893			892.97					891.90 SS W/ SULFIDE FILLED OIL FRACTURES 892.23 893.23 893.73 LOST CORE 894.44 BROKEN CORE
894								
895						CUT		INTERBURN TO HIGHER GRADE
896	-20							
897								896.71
898								MEDIUM GRADE

HOLE NO: X-11 SHEET 6 OF 8 DATE: 12/21/78 LOGGED BY: W MORTON COLLAR: ____ TD: ____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
900			898.57					898.77
901						STOP CORING 9:45 pm		HIGHER GRADE
902								901.89
903			.28, .18			902.82		SS. LENSES @ 901.12, 901.22, 901.45, 901.85, 902.1, 902.5, 904.3.3
904			.33					HIGHER GRADE SHALE / OIL SHALE INTER
905			.60, .64			START CORING 6:40 pm 12/21/78		TO HIGH GRADE
906	-40		.40					MEDIUM BROWN TO
907			.76					MEDIUM GRADE SHALE / BLACK. ~~SOME~~
908								AREAS OF ~~THIN~~
909								~~INTERBEDDED~~ LENS/BEDDING
910			.63					OF MARCOLITE.
911								
912								
913								MEDIUM GRADE OIL SHALE
914								WITH SOME HIGH GRADE
915								BANDS
916	-50		.45					
917			.65					
918			.75					
919			.51					
920			.75					MEDIUM GRADE OIL SHALE
921			.22, .71					
922		3'	31, .53, .80					
923		90°	.33					
924			.07, .50					
925			.50			RQD 90.12'		
926	-60		.10			1:00 PM		MEDIUM GRADE OIL SHALE
927		5' 90°	.5, .91					
928			.9.					
929			.21			BIT 3500' 14/ft		
930			.80					MEDIUM TO HIGH GRADE SHALE
931			.76					
932			.67, .91					NO SAND LAYERS IN RUN.
933			.20					OIL SHALE LOW TO MEDIUM
934								GRADE ~~WITH~~ WITH LAYERS
935			.29					OF HIGH GRADE - LIGHT BRN
936	-70							TO BLACK SOME LAYERS
937			.35					OF MARCOLITE AND SANDSTONE
938								SANDSTONE LAYERS OOZING
939								BITUMEN
940								940.59 - .73
941								940.92 - .96 SANDSTONE LAYER OIL SATURATED
942								
943								
944								MEDIUM TO LOW GRADE
945						RET. 945' RQD 100% 12/21/78 6:30 PM		OIL SHALE
946	-90							
947								
948								
949								

THE CLEVELAND CLIFFS IRON CO. PROJECT: UMC-2

HOLE NO: X-11 SHEET 7 OF 8 DATE: 12/22/76 LOGGED BY: W. NOULTEN COLLAR: ____ TD: ____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	CAL/TON	REC. & RQD	LITH.	DESCRIPTION
950								OIL SHALE
951								LOW TO MEDIUM GRADE
952	I=16	I 10°						
953			.30					
954								
955								
956	-90							
957								
958								SANDSTONE LAYERS & LENS 958.1 - .25 OIL SATURATED
959								
960								NUMEROUS THIN SANDSTONE LAYERS & LENS
961								OIL SATURATED INNER BEDDED WITH
962								LOW GRADE OIL SHALE.
963			.50			963.0A		thin ss bleeding for 962 - 96.8
964								with pyr thin ss bleeding for Low grade oil
965								shale, silty, finely laminated, sl. calc
966	-100		.60					carbonaceous with thin zones & seams
967								that are oil & tar saturated
968								968-97.0 oil shale, lt brn low grade
969			35 .65					
970		15°	90 .20					thin ss: ss - oil saturated
971			.20					970.5 - 97.8 oil saturated shale.
972								Shale, low to med grade,
973								competent, non-calc, silty, finely
974								laminated
975			.60					same as above with thin zones of
976	-120							oil bleeding
977								Shale, low grade, lt gy - buff
978								silty, competent, sl calc.
979								
980								
981								
982								
983			.25 .35 .70					Shale, low grade, cream to buff
984								Surface has "gitted" look, several
985			30 .60					
986		65°	.80					parting planes, non-calc
987	-130	10° 90°						Shale, low grade, gray, fine grained than
988								above.
989			.70					OIL SHALE, med grade, brn-dk brn
990								fine grained, finely laminated, some
991			.50					muddy distorted bedding (algal blebs)
992								SHALE, very low grade, lt gray,
993			.00					finely laminated
994	-134							

Cum 89.5 ft. Recov. 30.2 = 32.2 ft. FINISHED CORING RUN @ 11:45 AM

THE CLEVELAND CLIFFS IRON CO. PROJECT:

HOLE NO: X-1 SHEET 8 OF 8 DATE: 12-29-64 LOGGED BY: W. Kennedy COLLAR: TD:

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
992						992.3		
3								LOW GRADE LT. BR. OIL SHALE
4								BEDDING MARKED BY THIN
5			.50					SS LAYERS & LENSES
6								993.4 Oil Sat.
7			.21					
8								PYRITE LENS
9			.60					
1000			.20 10	.45				
1			1.5 .2					PYRITE LENS. 1001.8 - 1002 SS
2								LT BROWN LOW GR. OIL SHALE
3								
4			.65					
5								SS OIL SATURATED
6			1.5 .6					
7								
8			.36					
9			.45					1009.5 OIL SATURATED
1010								LENSES OF PYRITE 1010.3 Oil Sat.
11			.22 .5	.5				1011 - 1012 PARR BANDS
12								"
13								
14			.42					"
15								
16			.50					"
17			.20 .35	.42				
18								THIN SS.
19			.45 .2					
20								
21			.90					
22								
23								
						1023		HOLE COMPLETE

VI. HISTORIC AND SCIENTIFIC INVESTIGATIONS

VI. HISTORIC AND SCIENTIFIC INVESTIGATIONS

NO DATA THIS QUARTER